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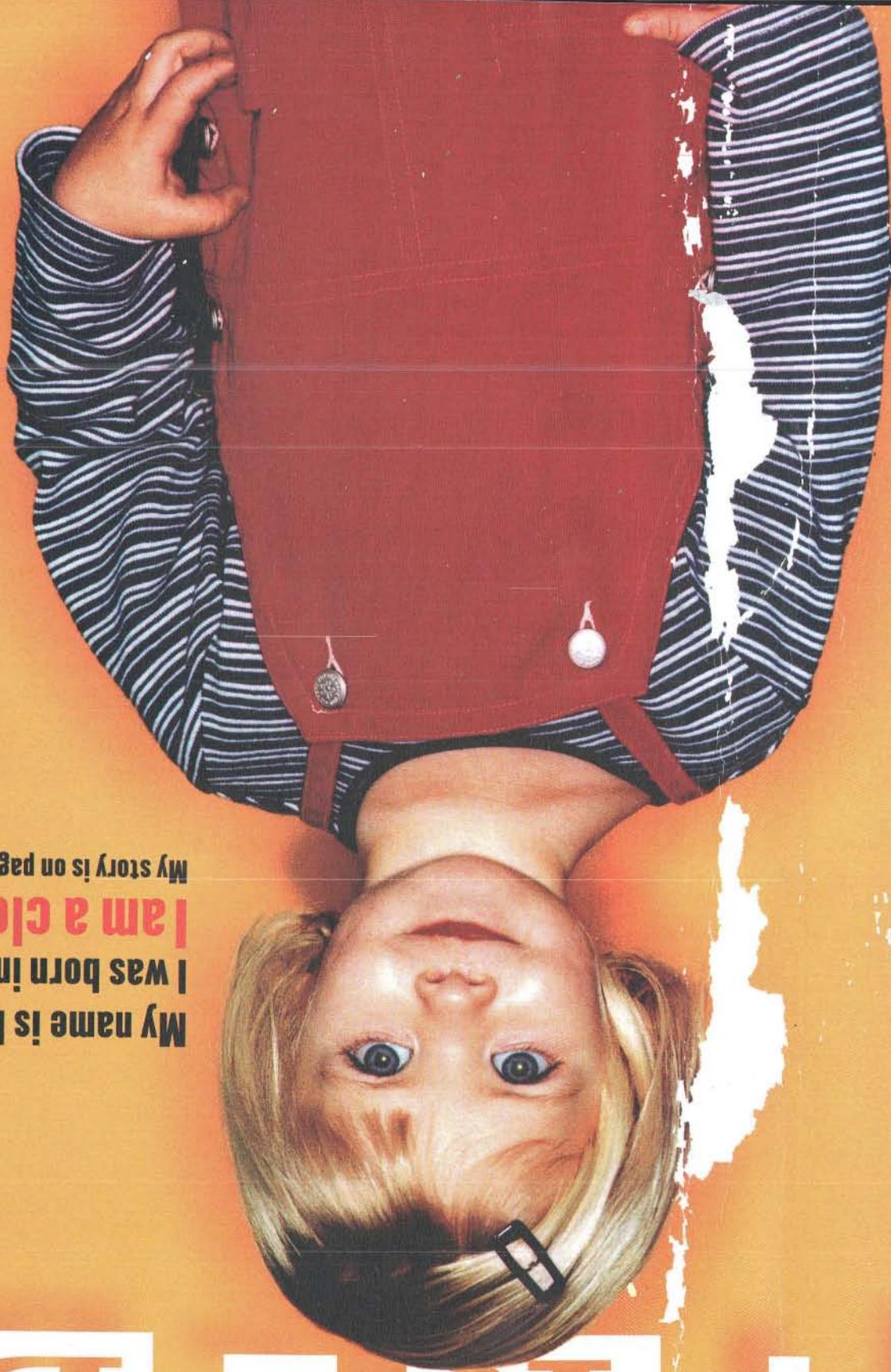
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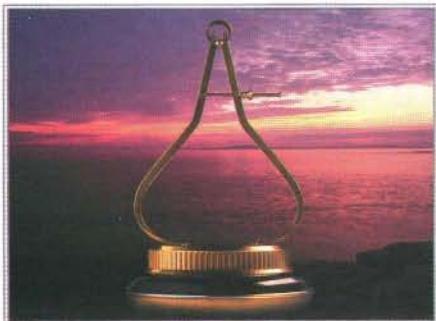
March 1998

{The honest-to-goodness truth}

If we had just removed the roof,

By David Hill, Corv

When we set out to create the C5 Corvette, winning awards was never our intent. That said, it's always nice to be recognized by automotive

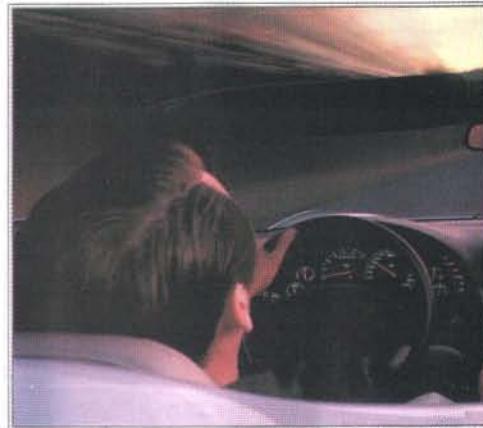


{ We're proud to announce that the C5 Corvette is the recipient of the 1998 Motor Trend Car of the Year Award. }

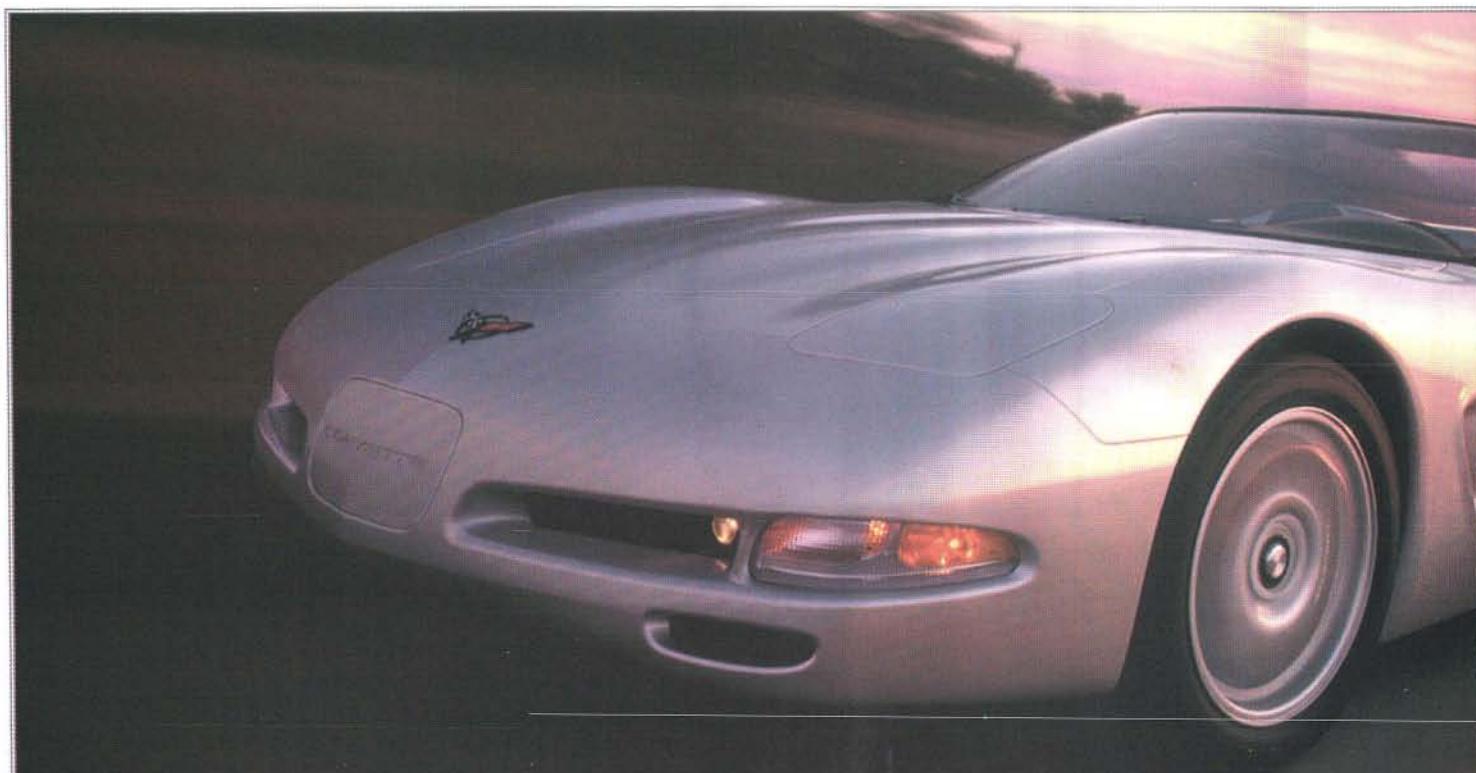
cognoscenti. Our aim was to make a sports car that handles superbly, whether a coupe or a convertible. To achieve that end, it was critical that we didn't chop the top off a coupe and call it a convertible.

Rather, we had to design the newest Corvette as a convertible right from the outset. It was the best way, the only way in our minds, to make a car with extraordinary feel and handling.

Stiffness and Strength We didn't want this car to suffer from the ride setbacks other convertibles typically have. One particular concern was how to avoid cowl shake, a common side effect of removing a car's roof. So, we made the structure very rigid. The previous 48-piece frame rails were replaced with twin seamless hydroformed tubes. Our new hydroformed frame rail is much more durable than a welded-up one. In fact, the structure was tested to endure up to three lifetimes of Corvette usage. And not only is the C5



{ The C5 was designed without a roof from the beginning so we four-and-a-half times stiffer structurally than its predecessor, it also has a lower curb weight. The difference in rigidity is immediately noticeable; lateral shake is virtually gone. Ride and handling are coupe-like.



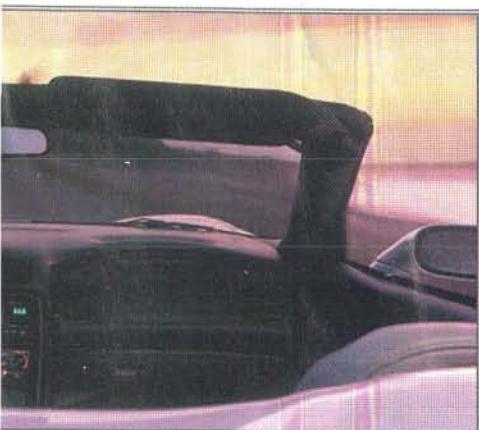
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T h e N e x t C o r v e

about the C5 Corvette, after all.)

it would have been a tragedy.

ette Chief Engineer



could make a world-class sports car that's also a convertible. }

A User-Friendly Convertible Once we perfected the structure, our next priority was to make every millimeter of the car work for the driver, especially in terms of comfort, spaciousness and cargo. We wanted the car to be easy on the driver, a rare

feat in convertibles. So, the controls and functions were placed where it would be natural to reach for them. Entry and exit are easier because door-sills are almost four inches lower. We've increased the hip, shoulder and leg room. There is four times more cargo space with the top down than with a C4. Partly responsible for this are the run-flat tires, which make a bulky and weight-adding spare tire unnecessary. (The instrument panel will alert drivers when a tire needs air.) These measures were taken simply because we wanted customers to avoid inconvenience wherever possible.

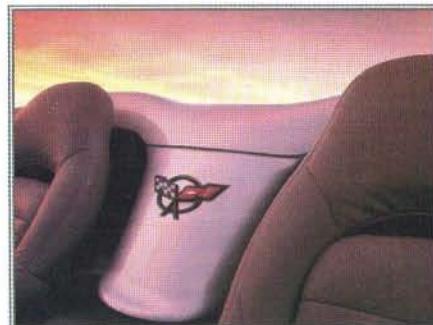
Power and Performance An obvious worry was whether we would lose the true spirit of a sports car by making it too civilized. We went to great lengths to keep that spirit alive. The newest Corvette has an aluminum small-block V8 that produces 345 horsepower at 5600 rpm, 350 lb.-ft. of torque at 4400 rpm and, in coupe form, achieves a 175-mph top speed.

Although it delivers more horsepower and torque than the iron version it succeeds, the C5 engine weighs 44 pounds less and is smaller in size. Basically, we packed more power into a more compact unit. We could keep the hoodline low, which would improve both aerodynamics and driver visibility.

Making No Compromises Perhaps the most vocal customer opinion was that they wanted a no-compromise sports car; they didn't want to sacrifice ride comfort for the sake of performance. We found breakthrough methods to meet those requirements. Like the composite, balsa wood-

cored floor. It minimizes vibrations for the cockpit occupants, while being both lightweight and strong enough to help deliver a more fatigue-free driving experience.

The stiff new structure and revised suspension also demonstrate how there are no take-aways in the new convertible. By shifting the transaxle to



Design attributes like the nostalgic waterfall make the new C5 immediately recognizable as a Corvette. }

the rear, we opened up more leg room. This also freed up room for a structural tunnel down the middle of the car, which increased its rigidity. That rigidity lets the suspension do its job properly; instead of compensating for chassis flex, it can focus on the most important things: precise handling and a smooth ride.

The Next Corvette The C5 convertible proves it is possible to marry high performance with top-down freedom. Simply put, this thing is incredible. Even more than the coupe, it will far exceed people's expectations. It even exceeded mine.

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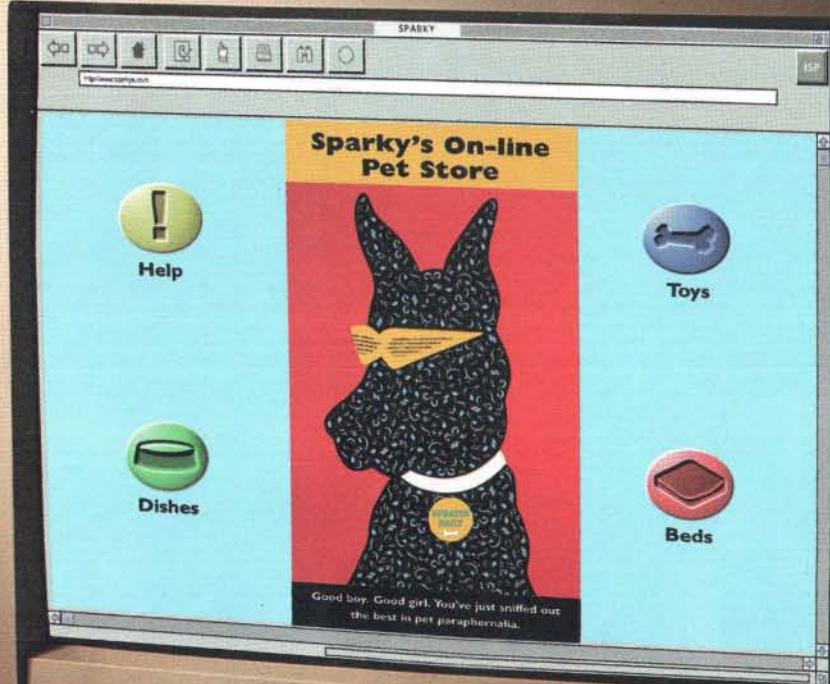
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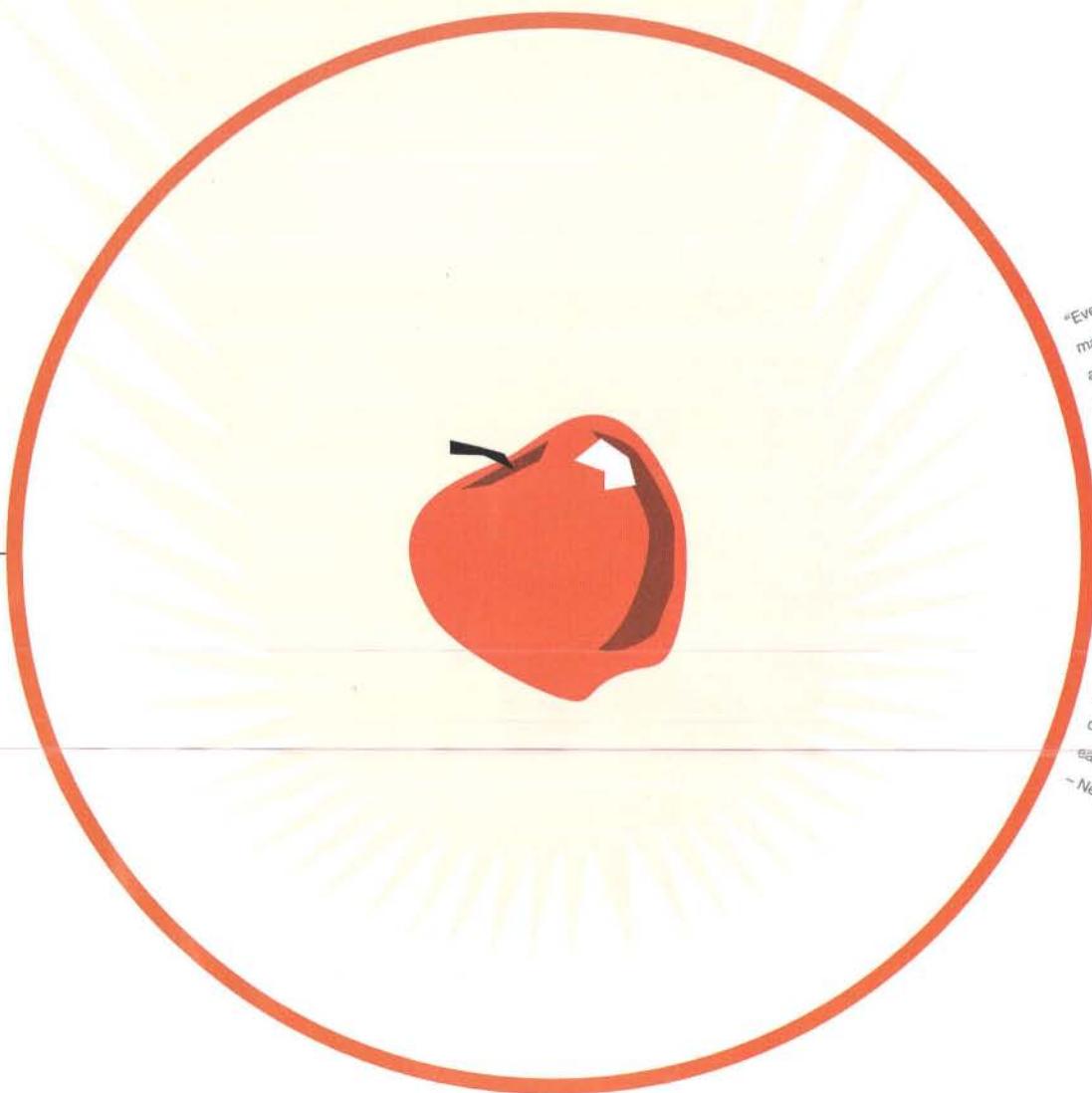
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— Ron Kocozier, in "Breaking the Law of Gravity,"

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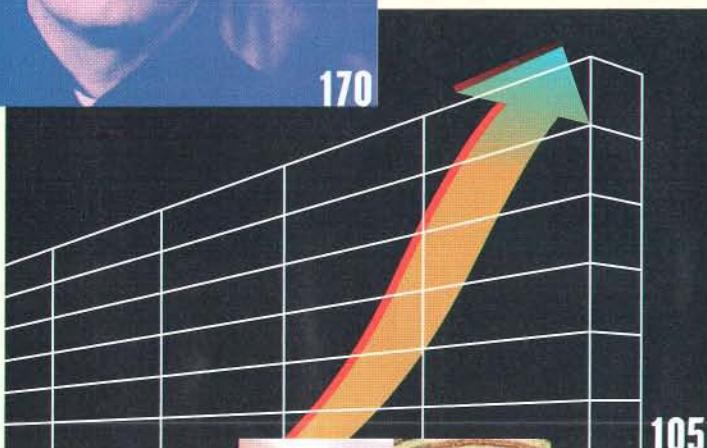
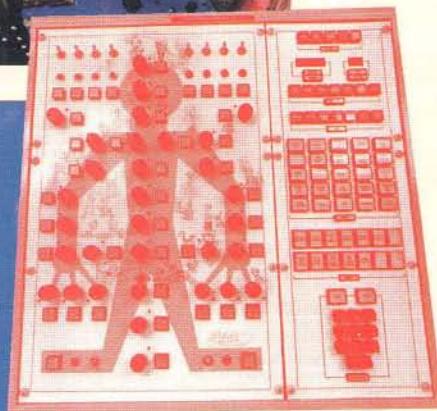
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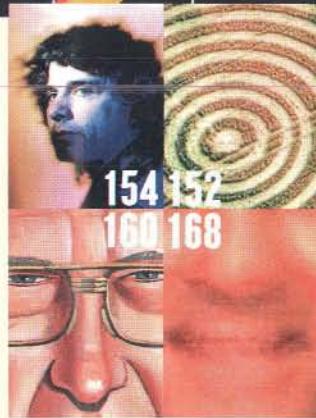




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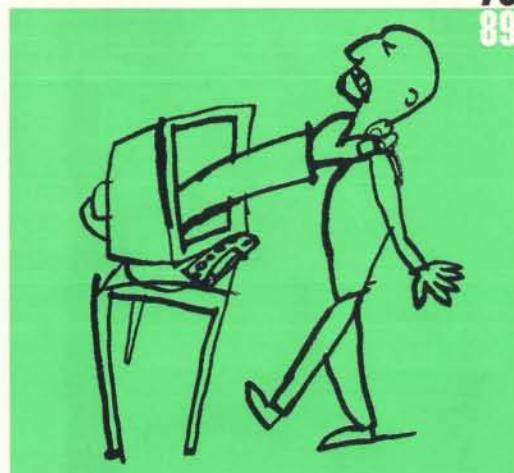
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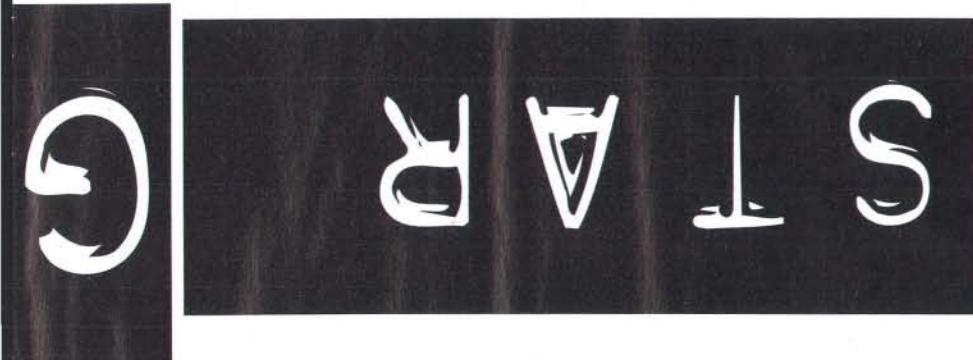
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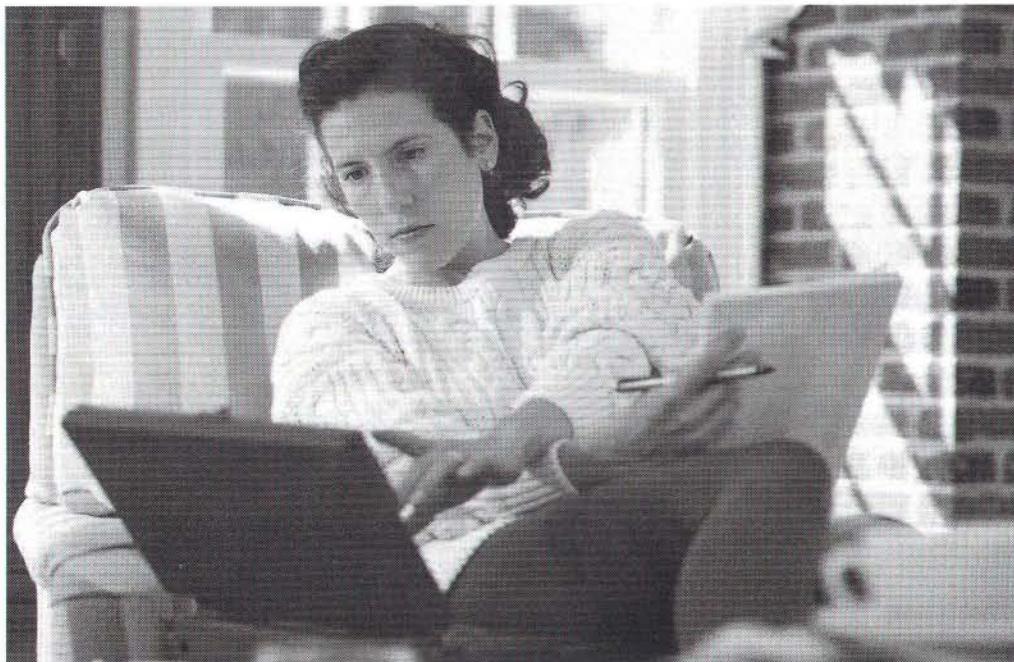
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Survey Says

I cringe whenever unsupported conclusions are drawn from poorly designed surveys. The Digital Citizen survey (*Wired* 5.12, page 68) is an unfortunate example of this malady.

Designed to measure levels of digital "connectedness," the survey in fact measures levels of affluence. It should come as no surprise that individuals with enough money to afford a laptop, a cell phone, a beeper, and a home computer are also likely to believe in democracy, feel in control of change, and be optimistic about their future. Duh: the system works for them. Why would they feel any other way?

Wired would have gotten the same result if the researchers had compared the attitudes of those who drive a Lexus to work with the attitudes of those who take the bus.

Yet Jon Katz goes on to fabricate a cause-and-effect relationship that is completely unsupported by the study. "Clearly, there is now evidence that technology promotes democracy, citizenship, knowledge, literacy, and community," Katz writes. This is pure conjecture. In fact, the survey identifies a correlation only; it does not determine cause and effect in any direction.

Lars Kongshem

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Pollster Frank Luntz's secondary analyses of the Wired/Merrill Lynch Forum Digital Citizen Survey results reveal that two people of similar age, race, education, and income are likely to have different views about politics and society if one is connected and the other is not. (Full survey results at www.hotwired.com/special/citizen/).

Digital Cynic

So, 95 percent of the superconnected worship free markets, while only 59 percent believe in democracy. Is it some epiphany that employed, economically ascendant people should believe in free markets more than in democracy? Could it be that the unconnected – the poor, uneducated, economically stagnated – believe less in markets and democracy not because they are less concerned citizens, but because they have been screwed by both?

The connected folks are savvy about the workings of our economy: 50 percent believe that who you know is more important in getting ahead than what you know. The unconnected cling to the propaganda that what you know counts. What does it say about opportunity in the US that the class universally viewed as the final product of a perfect meritocracy doesn't really believe that merit is what got them there?

Clearly, the connected folks suspect that our democracy may actually be a sham. They believe that Bill Gates and Bill Clinton have an almost equal impact on the US. The unconnected cling to the ludicrous myth that a democratically elected president has more influence on the country than an unelected, undemocratic, monopoly-building billionaire. Who is the cynic, and who is the citizen?

David Maizenberg

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**Attention Deficiency**

What a frightening world this would be if attention became our currency, for attention is the currency of children, who scream at the top of their lungs until some haggard adult appeases their need for food, affection, et cetera (*Wired* 5.12, page 182).

By motivating attention-getting behavior that disrupts society, the attention economy could have warped results. Face it, who gets the

most attention? Charles Manson pops to mind. Of course, not all those rich in attention are criminally insane. There's Madonna, Jerry Seinfeld, and Michael Jordan. You can't criticize these people for what they do. But what about the guy who actually works for a living – the anonymous Joe who fixes the pipes when they burst or the gal who puts the widget on the doohickey to make a microchip? Where will they fit in this new economy?

Adam Schair

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Which Came First?

Jon Katz's "The Digital Citizen" makes it clear that many people regard communications technology as the driving force behind social and economic change. However, in a modern capitalist society, technology is a tool to help us adapt to and manage change in an increasingly competitive world – it is not some mysterious driving force behind change.

Dave Amis

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Get Real

"Attention Shoppers!" has some good points, but Michael Goldhaber's definition of attention as a "limited resource" that could completely replace money is thoughtless. Economies have always revolved around physical things – land, money, or some other tangible good that could be counted and sorted. Goldhaber's currencies of the future are metaphysical resources: attention, intelligence, desire, hate. While metaphysical resources can indirectly affect physical economics – think of brand names – they could never become the standard of currency in a physical world.

Kevin Hill

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Man Versus Machine

While one can argue that manned programs like the space shuttle and the International Space Station are expensive and wasteful ("Lost in Space," *Wired* 5.12, page 226), it is a leap of logic to thus assume, as Piers Bizony does, that sending humans into space is unnecessary and undesirable.

Bizony falls into the old "humans versus robots" argument that has ripped through science communities for decades. This should not be an either/or proposition. The best way to study the solar system, and to search for evidence of past or present life on worlds like Mars and Europa, is through a combination of preliminary robotic missions and intensive follow-up studies by the most advanced, most knowledgeable, most innovative research devices yet known: humans. As development of reusable launch vehicles makes access to space less expensive, the same inner drive that led us across land and sea will compel us to journey into outer space.

Jeff Foust
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Magic Kingdom

Piers Bizony missed the most important aspect of the great space debate: the involvement of private enterprise. The satellite-based telecom industry generates billions of dollars annually and provides thousands of jobs. NASA and JPL, by comparison, amount to chump change. The main problem with the International Space Station is not its lack of a mission

— "to see how people can live and work in space" — but its choice of partners. Forget Europe, Japan, and especially Russia. Go with Walt Disney. Disney World may be overhyped and expensive, but it still draws millions of people from around the world. Let's make the ISS the Epcot in space.

Bill Stuckey
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Innocent Little Angels

In "Virtual Danger" (*Wired* 5.11, page 118), I found a gem of a sentence: "Children continue to serve as pawns in America's culture wars." It is so true! No one consulted us about the laws designed to protect us. Why? Because those laws are really designed for the parents. I mean, seriously, how will we be permanently scarred by porn? The Communications Decency Act, the Platform for Internet Content Selection, and the Child Pornography Prevention Act serve the interests of parents who want to believe that their children are innocent little angels. Uh-oh, I better send this — here comes my mom.

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Fighting the Virus

As a Bulgarian, I was extremely interested to hear David S. Ben-nahum's requiem of darkness ("Heart of Darkness," *Wired* 5.11, page 226). The chorus of cyber pirates reaches all possible notes of this *Viruso-Apocalypse Now*. The "evil empire" is dead. Long live the "virus empire"!

Sadly, the article demonizes thousands of talented Bulgarian programmers, many of whom work in top US companies and most of whom continue to fight the current economic crisis in Bulgaria — not with viruses, but with outstanding software creativity.

Arthur Kordon
kordon@sat.net

Portrait of the Artist as an Artist

Steven Holtzman's comments in "The Artist of the Future Is a Technologist" (*Wired* 5.12, page 256) are the uneducated babble of an effete snob who wouldn't know art if it bit him in the ass. Art is only as good as the entity that creates it. The computer is just a new kind of paintbrush. It will *always* take true creative genius to produce great art, regardless of the medium. To say that "the future will not be dominated by any of these rare individuals" is no more than a tired '90s tread of the '60s cry "Power to the People!"

Mahlon F. Craft
kinukoyc@pcnet.com

Undo

Bug Bug: Patti Maes worked with Yezdi Lashkari, not Max Metral, programming Firefly's agents to learn from each other ("Pattie," *Wired* 5.12, page 236). ■ Renamed: Empirical Media ("Pattie," *Wired* 5.12, page 236) became WiseWire Corporation during the first quarter of 1997. ■ Overeager Spellchecker: Two protons that collide in an accelerator ("The Future Ruins of the Nuclear Age," *Wired* 5.12, page 240) are transformed into muons. ■ Horse Trade: Tito Pontecorvo ("The Future Ruins of the Nuclear Age," *Wired* 5.12, page 240) is holding the lead on the far right in the photograph on page 254. ■ Price Fix: The Night Mariner 260 (Wired Tools, *Wired* 5.12) sells for US\$2,495. ■ Illusive Illusion: The term *illusionary attention* ("Attention Shoppers!" *Wired* 5.12, page 182) should read *illusory attention*.

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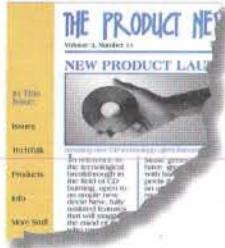
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Density Destiny

IBM engineers in Silicon Valley doubled their previous **record for magnetic storage** media, packing 11.6 billion bits of data (725,000 typed, double-spaced pages) per square inch of disk surface. The dense drives will come to market within four years. In the process, the price of 1 meg of disk memory will shrink to 3 cents (compared with US\$11.54 in 1988). Prediction: Bloatware will inflate as never before to fill up the cheap memory.

Boom Times

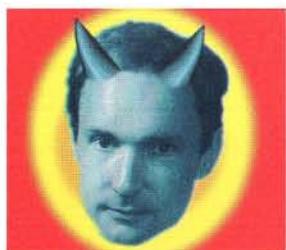
Continuing **economic turbulence in Southeast Asia** raised fears that the global boom could flatten into a dead thud. Worst-case scenario: China and Japan veer into the Pacific Rim pileup, and slow the global economy. Less-drastic vision: Tech sectors hit the brakes as Asian customers run out of cash. Reality: The question isn't whether, but when and how deeply the effects will be felt outside the region.

Tiananmen.gov

Chinese officials concluded that although the Internet can be a great force for modernization, the information it carries can damage the state. So the government introduced rules to control content and punish anyone who uses the Net to spread unorthodox views. It was **Deng Xiaoping all over again**: encourage economic freedoms while maintaining rigid political control. But will the tactic succeed on the Net? The real test comes only when China's tiny Net population expands. The current tally is a mere 250,000.

Our Censored Libraries

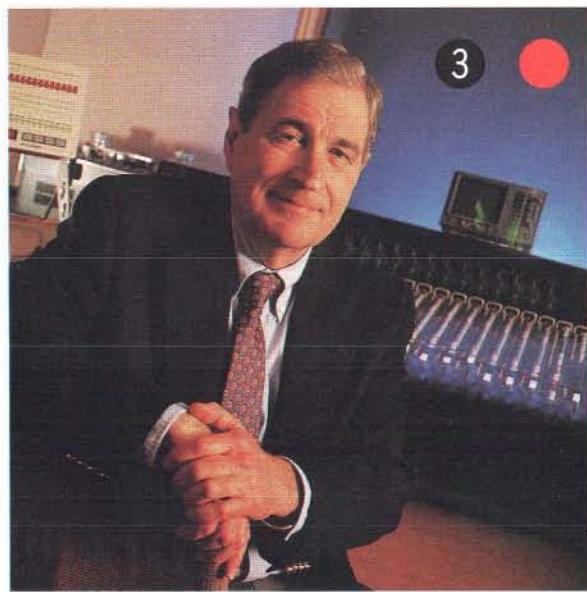
Libraries across the country witnessed the first shots in a landmark legal battle. Citizens in Loudoun County, Virginia, challenged the growing use of **Net-filtering** tools by public institutions. The group, Mainstream Loudoun, argued that library officials in the county outside Washington, DC, trampled the First Amendment by requiring patrons to use censorware and Net terminals to be placed where staff can see them.



Tim Berners-Lee: the PICS devil?

Taming the Net

After the World Wide Web Consortium refined its **Platform for Internet Content Selection**, the intended standard for rating and filtering sites, the Global Internet Liberty Campaign launched a free-speech attack, accusing the W3C of doing the devil's work by helping dictators and censors everywhere muzzle netizens. The response from W3C's Tim Berners-Lee: Our technology is good – but rights groups should remain vigilant.



"In Dolby stereo" audio pioneer Ray Dolby.

Recognized

Time's Man of the Year: Andy Grove, because the mag's editors were turned on by his escape-from-Budapest story. (Though we wonder why, as the most powerful chief outside Redmond, he's worth only \$350 million.) **National Medal of Technology: Vint Cerf and Robert Kahn**, for "creating and sustaining development of Internet protocols and continuing to provide leadership in the emerging industry of internetworking," and **Ray Dolby**, for his work developing sound-recording and playback technology.

TeleMelodrama

Ruling in favor of **SBC Communications Inc.**, a federal judge in Wichita Falls, Texas, declared the Telecom Act of '96 unconstitutional because it makes it too hard for SBC and sister Baby Bells to compete in the long distance market. The resulting salvo of appeals is likely to sink the ruling. But the episode will also speed up a congressional review of the much-litigated law.

9 8

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Netscape: Seeing Red

The webware shop's stock fell to \$18 – a record low – after the company announced a **fourth-quarter '97 loss** of \$85 million, and the staff layoffs began. **PR Spin One:** The numbers reflected a momentary dip as the firm moves from the browser trade to the corporate-enterprise business. **PR Spin Two:** Bill Gates's free-Internet Explorer strategy undercut Netscape's sales.

Reality: Netscape will have to give away its \$49.99 browsers to keep market share.

Microsoftening?

Microsoft declared that the only way to comply with Judge Thomas Penfield Jackson's order to offer a version of Windows 95 sans the Internet Explorer browser was to supply defective software. After being chastised by the judge, however, the software superpower allowed that its behavior might have been strident. And **Microsoft's** lawyers tried to assume a more polite tone of voice even as they continued to whine about the court-appointed special master, Lawrence Lessig. (See "The Special Master," page 99.)

But Judge Jackson called the polite brief "defamatory," and dismissed the company's filing.



Apple CEO-not Steve Jobs.

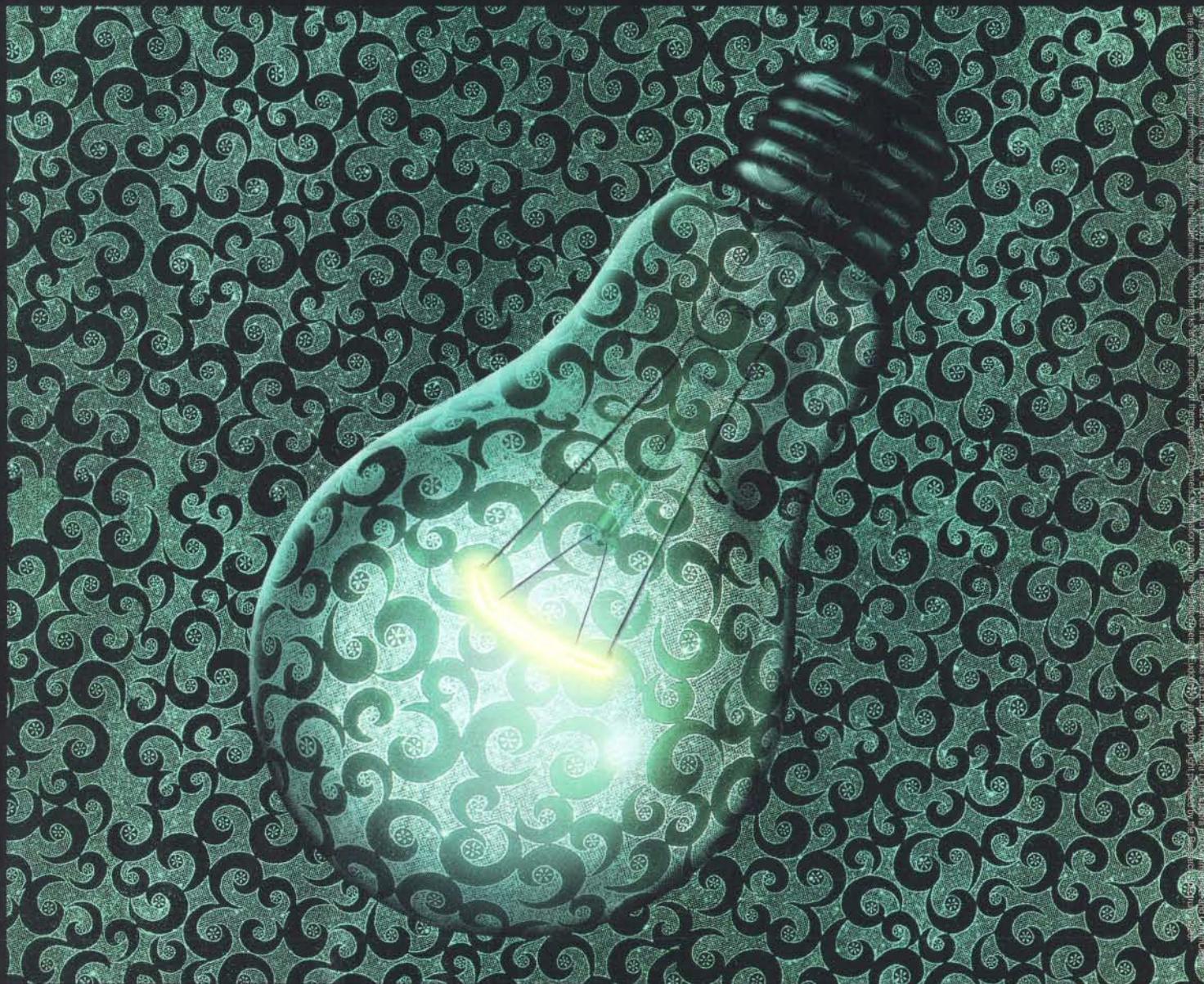
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The Prodigal Guy

The Mac's prodigal evangelist, **Guy Kawasaki** – now on leave writing *Rules for Revolutionaries* – is due to return to Apple this summer. But his return is looking less than likely. "Who in this business knows where they'll be in six months?" Kawasaki jokes of his plans. But his new venture, garage.com, is no joke. Kawasaki won't verify that the business will be a sort of venture capital network for non-VCs, but insiders familiar with his plans say the company will match angel investors with start-ups looking for the seed capital needed to get a great idea out of the garage.

Air Thresh

So **Dennis Fong** – aka Thresh – went pro. The 21-year-old videogame star from Berkeley, California, is competing in the rookie season of the Professional Gamers' League. Knowing that winning first prize in the PGL *Quake* season will earn him only US\$7,500, the young star is looking to endorsements for the big money. Several major equipment manufacturers have approached Thresh with deals starting in the low five figures. The joystick kid is even negotiating with one company about making a custom mouse and other Thresh products. But as his agent Peter Kim stresses, "Dennis is very, very picky about what he endorses."

Take Note

When IBM bought Lotus Corporation for \$3.5 billion in 1995, it was really buying Lotus Notes – and **Ray Ozzie**, its creator. Which is to say that you should pay attention to Ozzie and his new start-up, Rhythmix. Ozzie isn't talking specifics about the company's first product, except to say that the new software focuses on the same goal as Notes and Netscape – communication and collaboration – but with a different spin. And Ozzie has a luxury few software geniuses have even the second time around: a personal fortune of \$84 million that enables him to be the majority investor. As Ozzie's Rhythmix grows, take note.

A Gathering Storm

Current gaming powerhouses "are run by people completely alienated from the industry and its subculture," says **Mike Wilson**, of Ion Storm and id Software fame. The Wilson-organized Gathering of Developers aims to change that. His new company – a consortium of six big-name publishers – will create titles too alternative for mass appeal, real gamers' games that might make the suits in the marketing department uneasy. Wilson's gathering will release its first four titles this year.

The Unziff

Chris Anderson, the man behind the spring relaunch of *The Net*, says the repositioned mag (edited by former *Wired* features editor Jim Daly) will target "a business audience that understands the Internet explosion." The aspiring new media mogul from Britain also invested recently in the webzine *Feed*. Anderson's vision is best summed up by a billboard for his Imagine Publishing company that proclaims "www.notziff.com." Though a man of grand ambitions might want to aim even higher.



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ELECTRIC WORD

III



Boom or

BUST

Los Alamos National Laboratory researchers Kendall Hollis and Richard Castro do materials science. Tom Bollinger does sculpture. Their unlikely partnership grew out of the US government's technology-transfer program, which encourages federally funded laboratories to develop commercial applications for their technologies and make them available to local interests. In New Mexico, that means artists. So early this year Hollis and Castro, who admits he "can't even draw a dog," contacted

Bollinger, then head of a nearby foundry. Working together, the three transformed a nuclear weapons storage technology into art. The technique uses an electrical charge to melt metal wires and then spray the molten liquid onto an object, creating a corrosion-resistant polished surface. The process is more flexible than conventional casting methods: different metals – or any material with a melting point – can be blended seamlessly, and the coating can be spread as thin as a few thousandths of an inch.

Call it the National Security Endowment for the Arts.
— Jessie Scanlon



on the other side.
upside down people lived
was flat and that
I thought the world



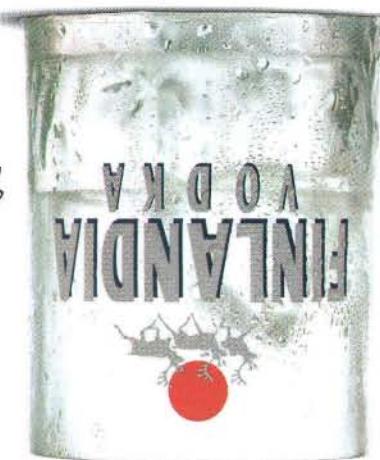
when I awoke.
Dare I use a flashlight

eighteen never.
A man does not stay
to the values of Greece.
But Greece, ah, my apologies
Spain or France, or Italy.
Heart broken in all of
a great lover. I left not a
In a past life I was



Finlandia Vodka 40% ALC/VOL. Imported by Brown-Forman Beverages Worldwide, Louisville, KY 01997 ALCO GROUP LTD.
Enjoy Finlandia's pure taste responsibly.

of water pure,
of taste/quality natural





DOME IN PROGRESS, MECOM, MECCO, MECCA, MECOM, MECCA, MECOM, MECCA

WIRED MARCH 1998



In East London, on the Greenwich prime meridian, 12 yellow steel masts soar 328 feet above the horizon, the first signs of the Millennium Dome. Designed by Pompidou Centre architect Richard Rogers, the £40 million (US\$65 million) dome will be the centerpiece of the Millennium Experience, Britain's fin-de-siècle celebration.

It will also be the only lasting element: long after the futuristic exhibits close December 31, 2000, the structure will dominate this wasteland-by-the-Thames. Measuring 164 feet in height, 350 yards in diameter, and covering the 20 acres now cluttered with diggers and cranes, the dome will be the largest in the world when it is completed in late 1998. — Jessie Scanlon

Ground Zero Zero





T I R E D

Retin-A
Sarin
WAV files
Online communities
nest
WebTV box
Nintendo 64
Tamagotchi
Kai Tak
Think tanks



WIRED

Telomerase
Pokemon
MIDI over the Net
Online auctions
Echoes
Digital cable box
Project X
PostPet
Chek Lap Kok
Do tanks



Is Money

The little ticktock of the millennial clock will make US\$115 billion for a crowd of clever programmers, Y2K business consultants, and, of course, lawyers, according to International Data Corporation. Here's a sample of who's cashing in on the dreaded Year 2000 Problem.

— Jennifer Hillner

Steven Hock

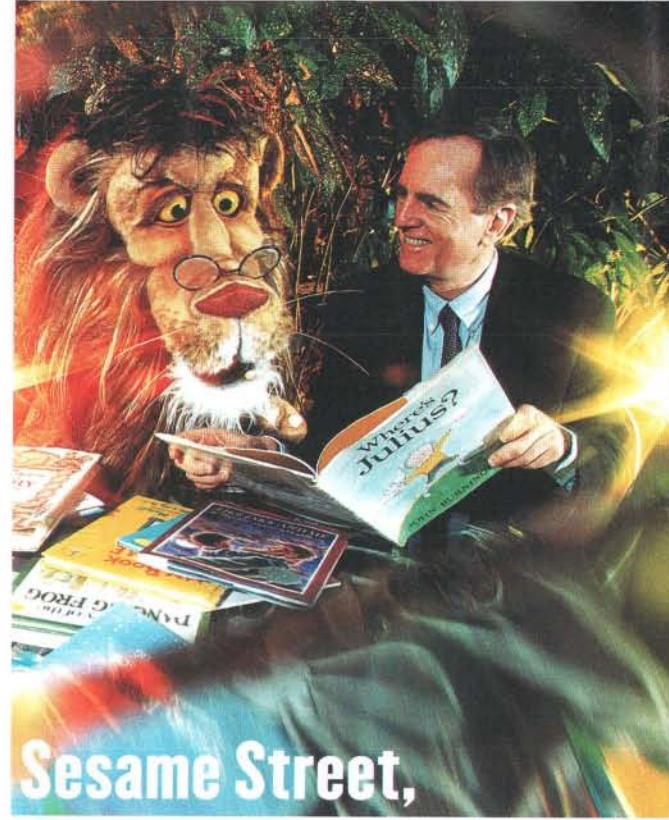
Title: Attorney at law
Affiliation: Thelen, Marrin, Johnson & Bridges
Salary: \$500,000 to \$2 million
Hock earns his millennial millions defending computer companies whose products suffer from the Y2K bug. This year, Hock and his 28-lawyer team will represent Software Business Technologies in a \$50 million class-action suit (the first major Y2K case to hit the courts), as well as three similar actions.

Jack O'Bryan

Title: Programmer/data systems consultant
Affiliation: Levi Strauss & Co.
Salary: \$120,000 to \$250,000
O'Bryan spends an average of 50 hours a week eyeballing code — miles of it — scanning for dates used in calculations or sequencing and then rewriting the code.

Cynthia Warner

Title: Acting director of the Strategic Information Technology Analysis Division
Affiliation: US Government Office of Information Technology, General Services Administration
Salary: \$77,000 to \$101,000
Warner is Uncle Sam's Y2K official, responsible for evaluating the Y2K effect on all federal agencies and hounding them to comply with official Y2K policy. She is also responsible for steering the federal Y2K logo through the US Patent Office.



Sesame Street, The Next Generation

Big Bird fans have something big to look forward to: *Between the Lions*. The show is the first product of Sirius Thinking Ltd., an educational programming company founded in 1994 by ex-Apple CEO John Sculley (above), along with Christopher Cerf, Michael Frith, and Norman Stiles — a creative trio whose combined résumé includes *Sesame Street* and Jim Henson Productions.

Like the classic children's show, *Between the Lions* offers the nuts and bolts of reading and phonics in the form of fantastical stories and animal characters. Unlike *Sesame Street*, however, the Sirius production uses sophisticated live action, animation, and 3-D rendering technologies and will exist in multiple media. Theo (above left), Cleo, and Click the Mouse will débüt on TV in 1999 — and then move on to the Web, books, and, as Sculley promises, "any media that words can be printed on." — Jessie Scanlon

Individual information for The Guardian Life Insurance Company of America as of 12/31/96
 Assets = \$12.1 billion. Liabilities = \$10.9 billion (includes \$8.5 billion in reserves). Surplus = \$2 billion
 401(k) products and variable annuities are issued by The Guardian Insurance & Annuity Company, Inc. (GICA), a wholly owned subsidiary of The Guardian Life Insurance Company of America. New York, NY. Securities products are distributed by Guardian Investor Services Corporation (GISC), 201 Park Avenue South, New York, NY, 1-800-221-3253. Member
 ADS, SIPC. GISC is an indirect wholly owned subsidiary of The Guardian Life Insurance Company of America.

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our Euromain agent will help you play in the big leagues.

1990-91: 11.7% (1990-91) 1991-92: 11.7% (1991-92)

Squarelair agents have delivered a level of personal service second to none.*

secure their financial futures. At the same time, added to help policymakers protect their families and

exit, The Guardian's dedicated agents have worked

or over 137 years, from one generation to the next, the family would be well

In fact, many polio survivors consider their Guardian Angels to be a long-time family friend as well.

Guardians of Guadalupe member of their financial team.

Financial success is often a team effort. And for

for polityouers.

Help develop winning strategies

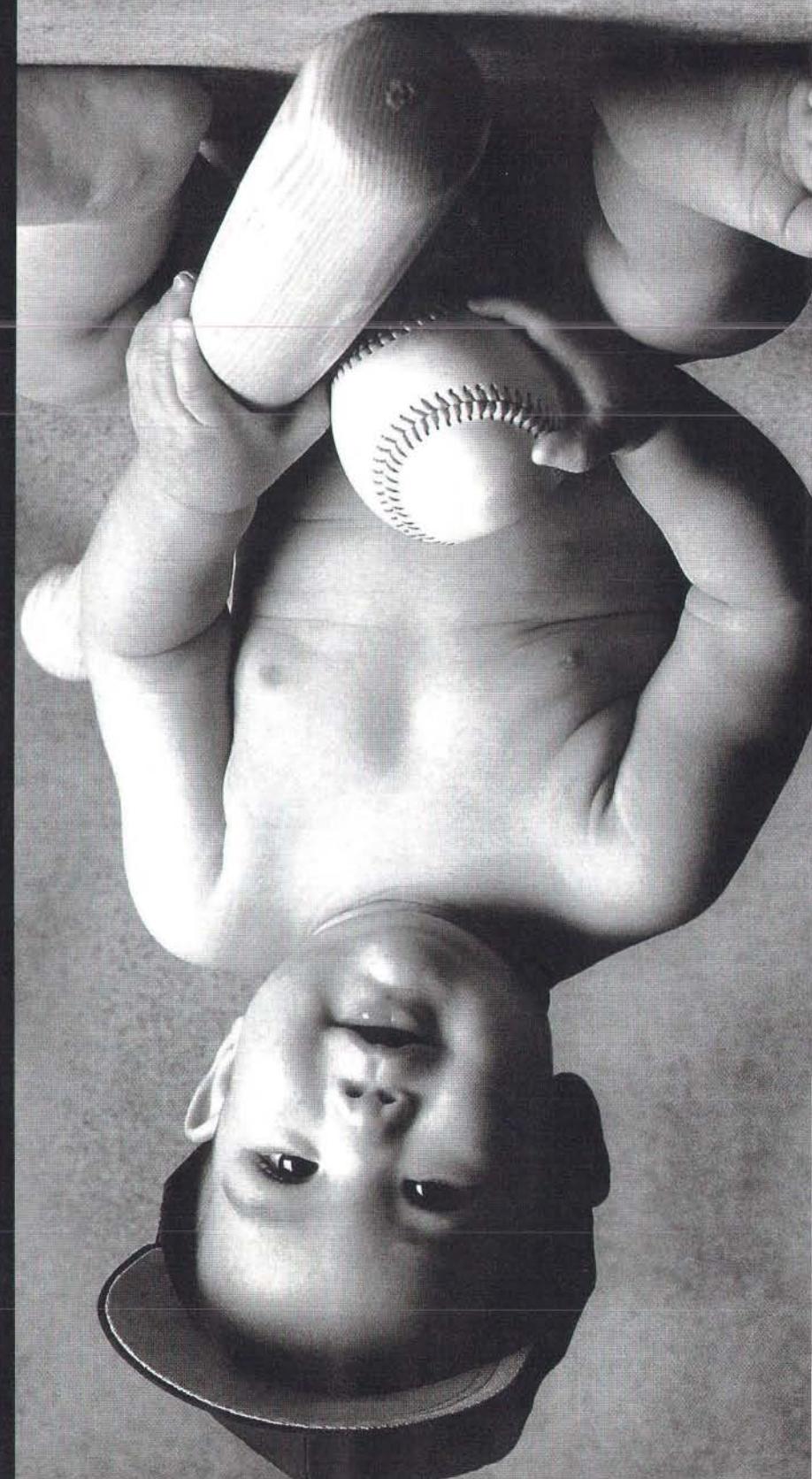
Company's professional agents

The Guardian Life Insurance

WILLIAM H. DAVIS

ANSWER

WILSON VALUABLE PLAYERS



S

Science fiction writer Marc Laidlaw has finally gotten a life, or at least half of one. Now you too can get a *Half-Life* when his first computer game is released in April. As Laidlaw tells it, the title "is going to do the stuff I always wanted games to do." *Half-Life's* finely rendered monsters may be brutish, but they're not dumb: AI developed by Valve, a Seattle game company, equips them with pack behavior, threat assessment, and – unlike most gorefest goons – a disinclination toward suicide attacks.

For Laidlaw, creating an adventure set in a demilitarized missile base invaded by extradimensional aliens sure beats toiling as a legal secretary, a job he had for 10 years before landing at Valve. For gamers, entering a world written by a master storyteller makes it that much more fun to blow away the bad guys.

—Mark Frauenfelder

Getting a Half-Life



The standard Robotics kit includes:

RCX Brick

The RCX brick has an 8-bit processor and memory for five programs, each capable of executing nine tasks simultaneously.

Light Sensor

Does the light stay on when the refrigerator door shuts? Plug a light sensor into one of the brick's three input ports, build a body and some arms and legs, stick it in the fridge, and you'll have an answer. Or at least the Legobot will.

Touch Sensor

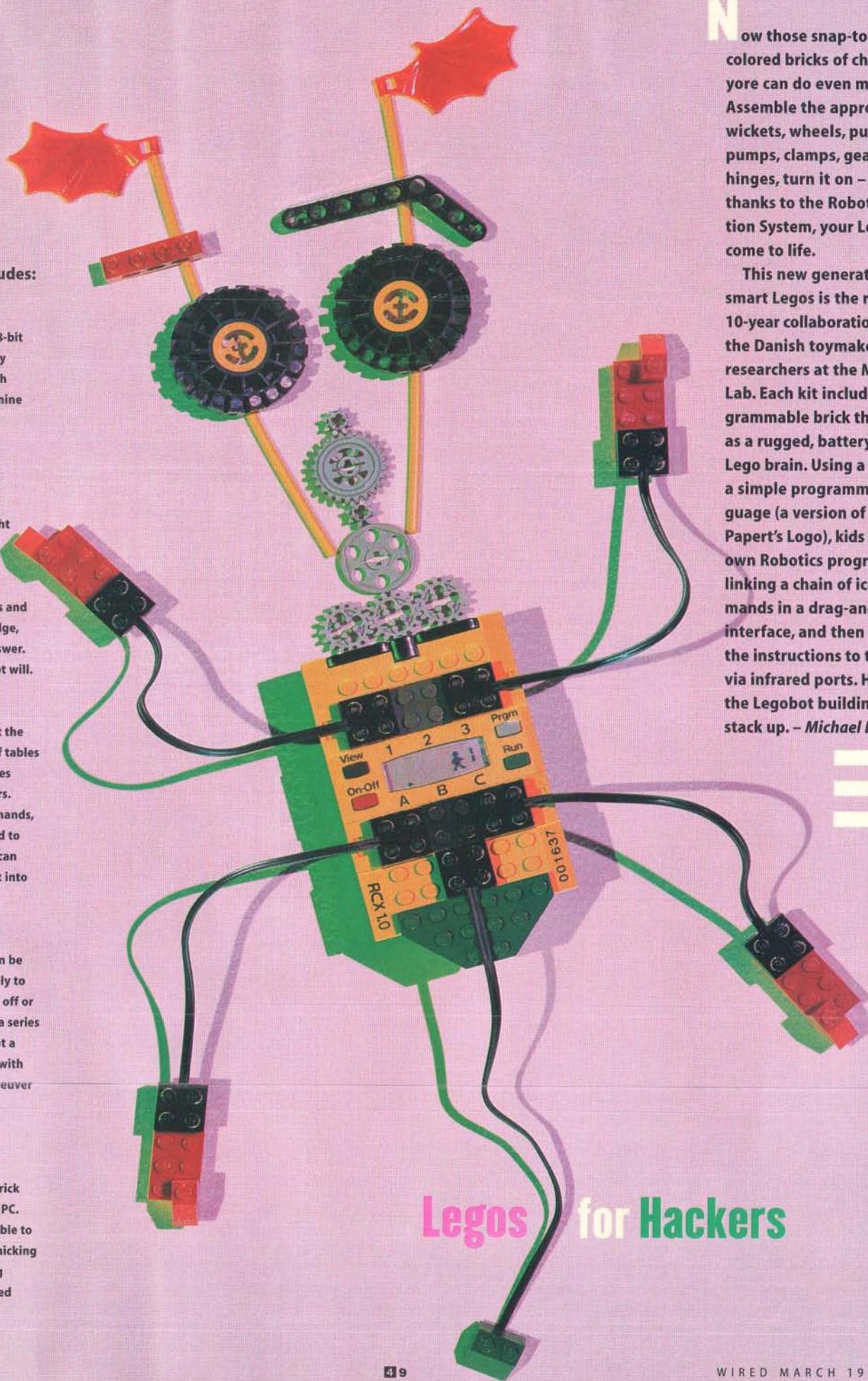
Touch sensors prevent the robots from falling off tables or thrusting themselves repeatedly into corners. With a few basic commands, a bot can be instructed to clutch an empty beer can in its claws and drop it into a nearby recycle bin.

Motor Ports

Three control ports can be programmed separately to switch a motor on and off or vary speeds. Combine a series of gears and you've got a *Sojourner*-like vehicle with enough torque to maneuver over a phone book.

Infrared Ports

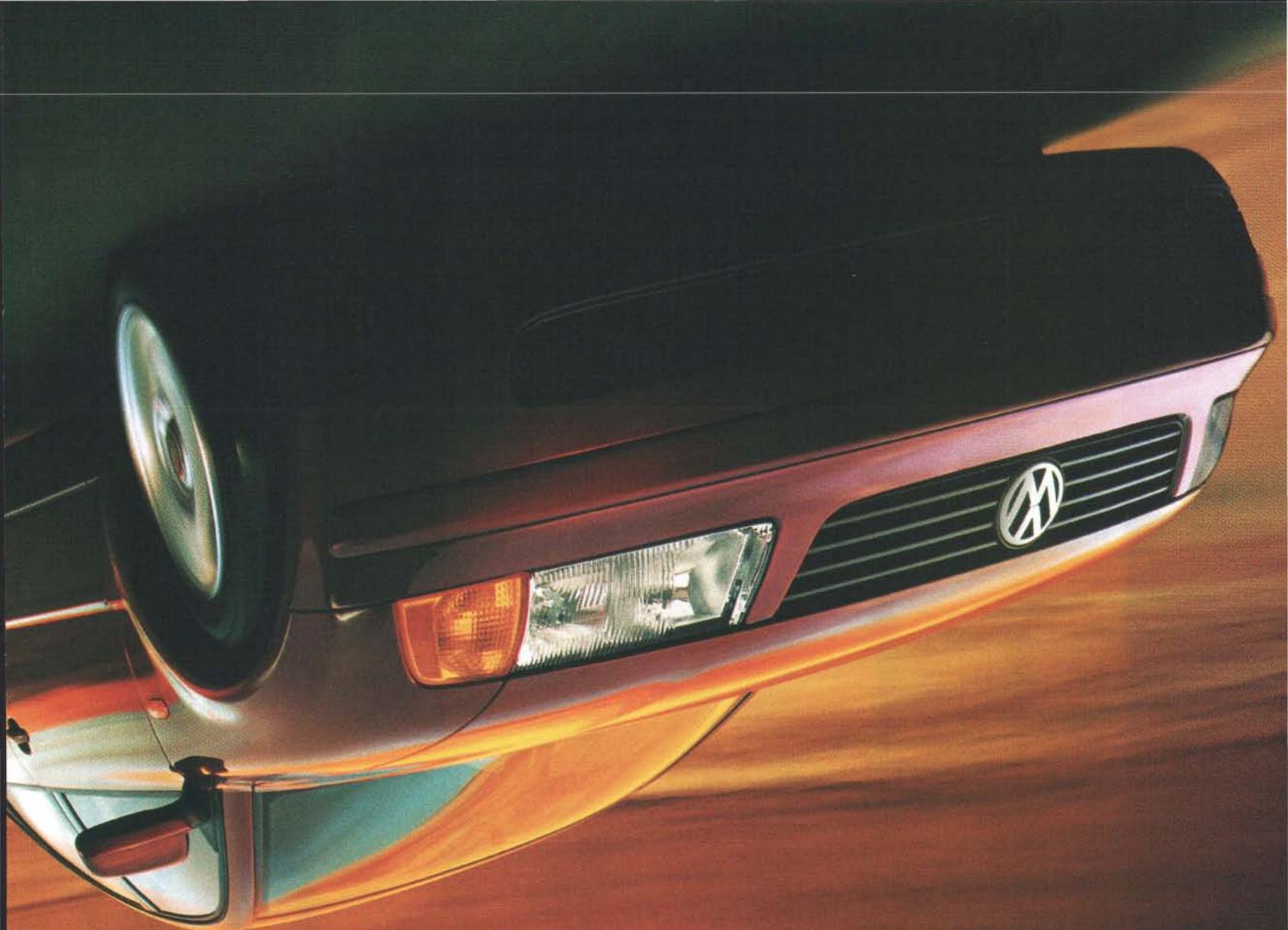
Two infrared ports are included: one on the brick itself and one for your PC. Future robots will be able to talk to each other, mimicking movements or working together on preassigned tasks.



Now those snap-together colored bricks of childhood yore can do even more. Assemble the appropriate wickets, wheels, pulleys, pumps, clamps, gears, and hinges, turn it on – and, thanks to the Robotics Invention System, your Legobots come to life.

This new generation of smart Legos is the result of a 10-year collaboration between the Danish toymaker and researchers at the MIT Media Lab. Each kit includes a programmable brick that serves as a rugged, battery-powered Lego brain. Using a PC and a simple programming language (a version of Seymour Papert's Logo), kids build their own Robotics programs by linking a chain of iconic commands in a drag-and-drop interface, and then download the instructions to the brick via infrared ports. Here's how the Legobot building blocks stack up. — Michael Behar

Legos for Hackers





Mutiny on the 101. It started with a whisper. The crew was unhappy. The cookie-cutter family sedan was the cause. For years they searched the horizon for a car that spoke to their hearts and souls, but found nothing. Then, they saw it. The new Volkswagen Passat. Starting at only \$20,750*, they felt it stood for the same things they did. The braver ones jumped ship first. More were sure to follow. Live large. The New Passat.

Drivers wanted. 

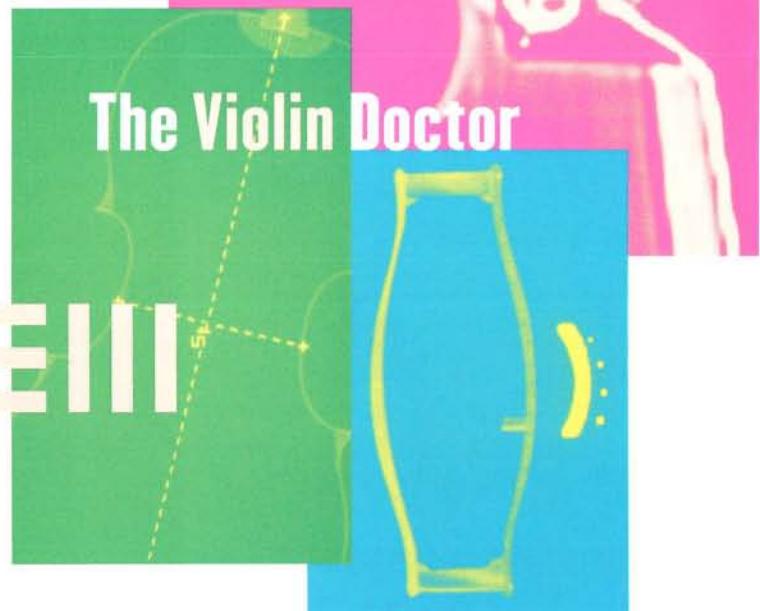
*Base MSRP. Price excludes taxes, registration, transportation and dealer charges. Dealer sets actual price. 5-valve engine technology. Traction control. Anti-lock brakes. And just about power everything. Talk to me baby. 1-800 DRIVE VW or www.vw.com. Always wear seatbelts. ©1997 Volkswagen.

I E T O P O

Downloads from the Internet Underground Music Archive

Song Title	Artist	Genre	Downloads
1. "Cow Lions Clowned Me"	Kaka Pussy	Spoken word/experimental	2,224
2. "Stop Your Pushin"	Pele Juju	World beat	1,420
3. "Forgotten"	Blue Noise Electric	Dance/techno	794
4. "Yum Yum"	1 Percent Hangout	Rap/hip hop	749
5. "I've Been Here Before"	Kelly Luttrell	Folk/pop	749
6. "One World!"	Gregory Abbott	Blues/pop	716
7. "Perfect Strangers"	Tonya Rae	Country	655
8. "Tom Song"	30 Foot Whipper	College/indie/hard rock	530
9. "Watching the Young"	23 Futurists	Ambient/electronic	517
10. "Alien Bliss"	Alien Bliss	Pop/rock/jazz	449

Note: As of November 1997, all artists on this list were unsigned. These figures are based on the number of people clicking on a link for the full-length version of a particular song in November 1997. Source: Internet Underground Music Archive (www.iuma.com/); compiled by Howard Wen. — Gareth Branwyn



J A R G O N W A T C H

Jithead

An international transportation term used to describe people who order goods on a "just in time" basis and then freak out when told that they didn't order early enough. "That jithead should have placed his order a month ago."

Diaper Change

One of several daily visits by a tech-support person to the desk of a particularly cranky, lazy, or technically incompetent user. "Sorry I was late, but I had to do a diaper change down in Accounting."

Lapjacking

The increasingly common practice, especially in airports, of stealing unattended laptop computers.

Lovejob

Graphics service bureau slang for a file that an art director obsessively wants output in every possible variation. "Yeah, I know we're ripping it to the Iris proofer for the

ninth time. This one's a lovejob."

Multislacking

When an employee has two browser windows open, a nonwork-related site on top of a productive one, and quickly clicks on the legitimate site whenever the boss is nearby.

Packet-centric

A growing focus in the telecom industry away from voice-dominant (circuit-centric) networks and toward IP packet networks as the future delivery system for combined data and telephony.

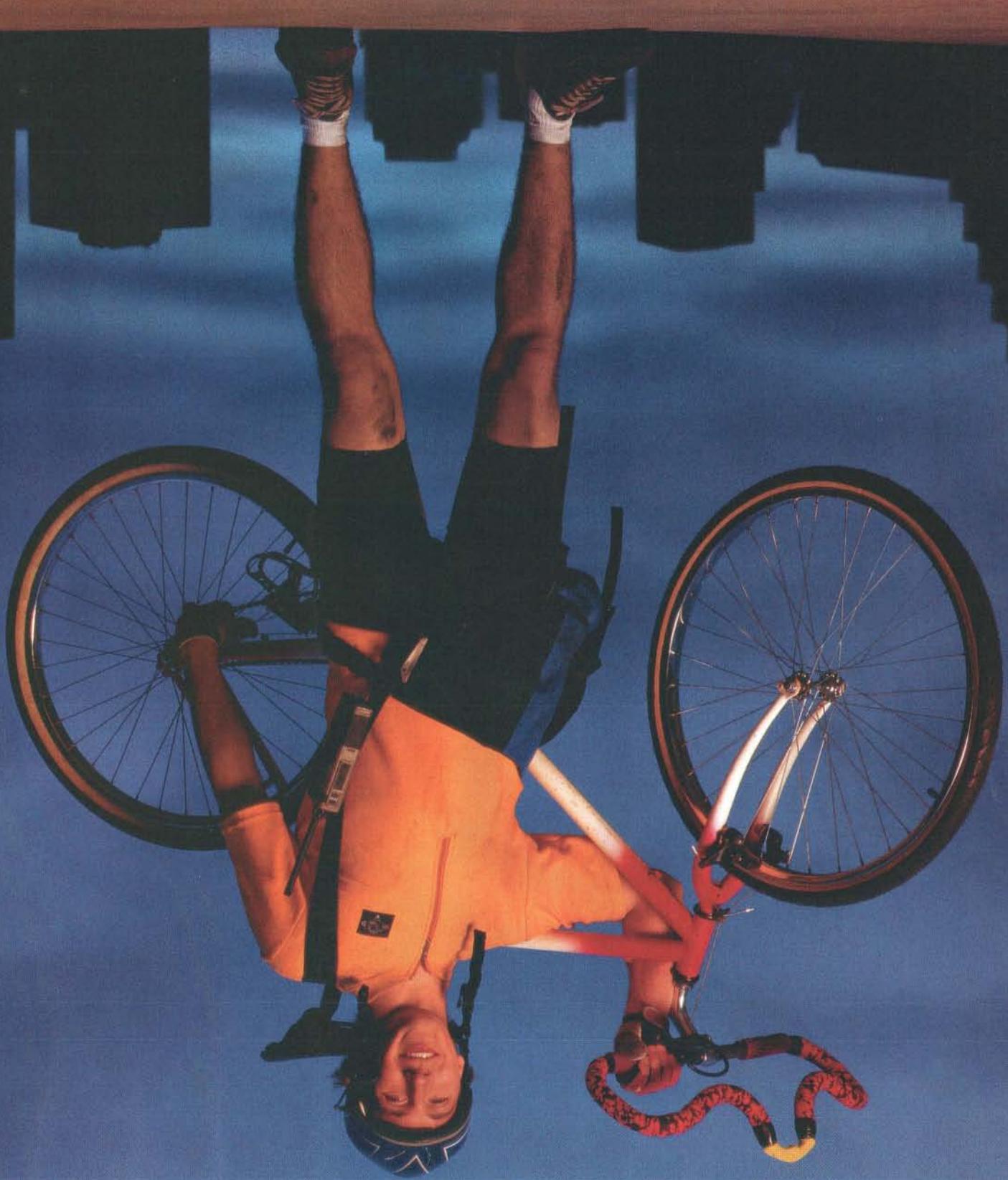
Tip o' the camouflage hunting hat to Judith Bookbinder, Warren S. Levine, and David Lipton.

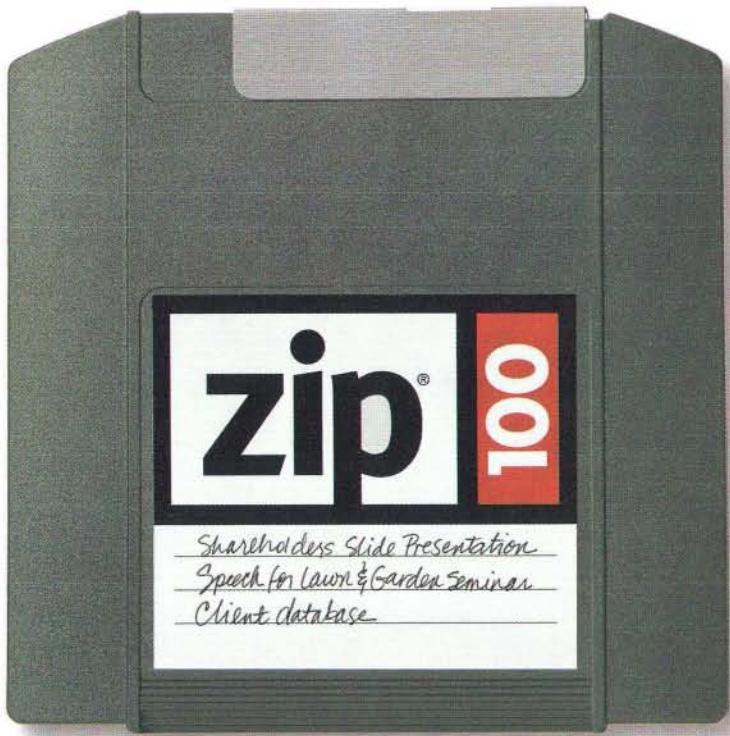
— Gareth Branwyn
(jargon@wired.com)



FROM THE FRONT DESK TO THE
CORNER OFFICE.
SOLUTIONS

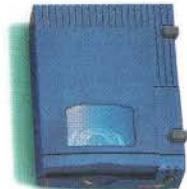
O F F I C E





Meet Josh. He makes regular deliveries to Austin Acres. Once a small town garden supply company.

Now a worldwide lawn equipment manufacturer that needs a big-time place to put all its stuff. That's why the Zip® drive and genuine 100MB Zip disks are perfect for Austin Acres and growing businesses like yours. They give you the freedom to carry stuff between the office, home, school, greenhouse, or wherever life takes you. Each Zip disk holds as much as 70 floppies. It's like having your own digital briefcase with more than enough room to store multimedia presentations, Internet downloads, months' worth of e-mails from your server, business records, and even pink flamingo orders. And with over 10 million drives out there, it's easy to see why people are getting carried away with the Zip drive.



Standard 100MB Zip disks for as low as \$12.95 each when purchased in 10-packs.

C O U R I E R

W O R K





Here's Carol, the lead engineer behind some of the most innovative weed-whacking devices around. She looks like a happy camper. Well, she is, because she uses a Jaz® drive. With over a million drives out there, lots of people are using the Jaz drive to help their businesses grow. The Jaz drive is perfect for storage-intense users and will definitely create more elbow room around the office. It's portable too—so you can take your stuff anywhere. With Jaz 1GB drives and cartridges, and the upcoming 2GB* drive, you'll have tons of room to store huge graphics, customer database files, or back up your entire hard drive. Along with the help of the new Buz Multimedia Producer,™ you'll be able to edit video and give knock-out multimedia presentations. Stretch out, you've got room.

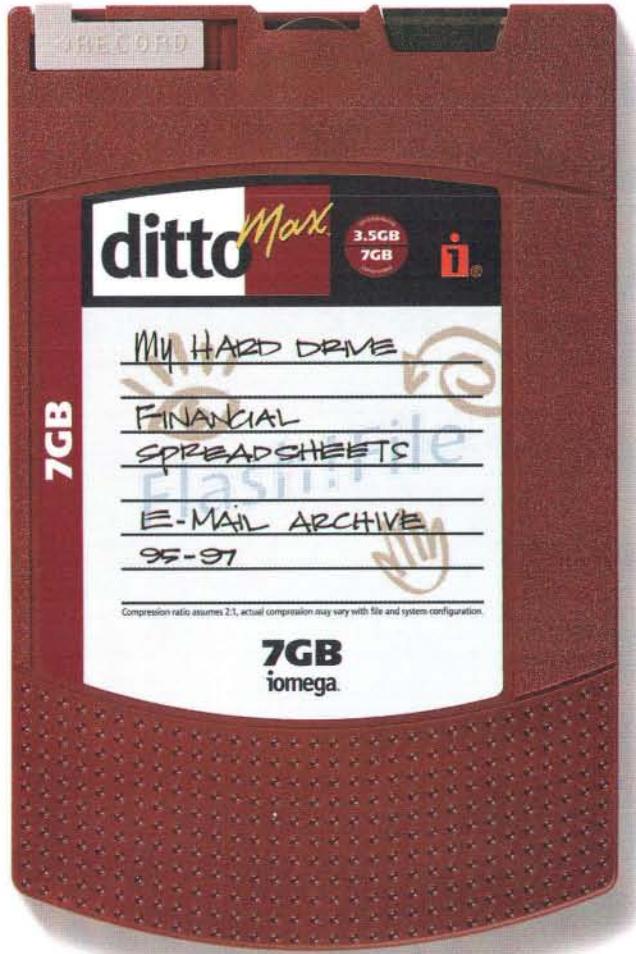


1GB Jaz cartridges start as low as \$89.95 when purchased in 3-packs.

S P A C E

C O R P O R A T E





Whoa, hold on there. This is George, head security guard. He makes sure everything is secure. But when it comes to securing your data, nothing works better than a Ditto Max™ drive.

It's like insurance for all the important business stuff on your computer. The Ditto Max backup solution, available with 3GB, 5GB, and 7GB compressed* capacity cartridges, is a heavyweight equipped to protect today's high-capacity hard drives. Whether they're year-end financial reports, tax records, top-secret formulas for greener lawns, or customer databases—Ditto Max drive protection is sure to make you feel nice and safe. And you'll feel even safer knowing it's from Iomega, the leader in personal storage solutions. So get a Ditto Max drive because, as you know, accidents can happen.

Not just on the lawn.



The Ditto Max drive handles 3GB, 5GB, and 7GB compressed* capacity cartridges.

S E C U R I T Y

P U B L I C





Actual size.

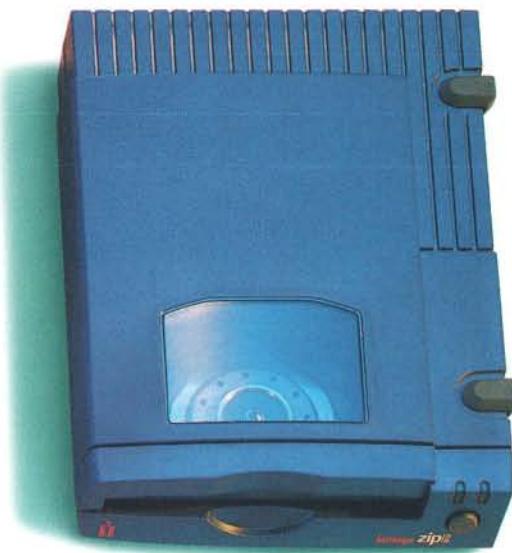
Say hello to Susan. She's a people person. As the head of Corporate PR, she is always on the road, bringing people together. From parties to conventions to shareholder meetings, she needs a cool way to take her stuff wherever she goes. Coming later this year for people on the go, there's Clik!™ the new 40MB matchbook-size solution for portable digital devices. Susan could use Clik! disks as a "digital roll of film" to transfer the photos of the annual party onto her sub-notebook and post them on the intranet, bringing her global company closer together. Clik! disks will allow portable devices like digital cameras, handheld PCs, PDAs, printers, and projection systems to truly interact, doing more and sharing more with each other. And with OEM support continually growing, lots of handheld devices will have Clik! drives built right in. Just think, with Clik! products, you could party on into the next millennium.



Clik! disks: 40MB of space
for under ten bucks.

R E L A T I O N S

The Iomega Zip® drive.
The Capacity To Do More.™



Iomega Ditto Max™ tape backup.

It's Like Insurance For The
Important Stuff On Your PC.™



Portability

100MB Zip disks are removable and the drive is portable. So you can shuttle your work stuff home, to the airport, to a client, and ultimately, back to work.

Organization and Expansion

Take control of your personal and business affairs with a Zip drive. Not only will you look good, but it's an inexpensive alternative to hard drive expansion. Use one disk for your yearly financial spreadsheets and forecasts, and another for hefty multimedia presentations. With 100 megs per disk, you'll have plenty of room for more.

Backup

You know you have a lot of files you wouldn't want to lose. So secure all your important stuff on Zip disks.

Security

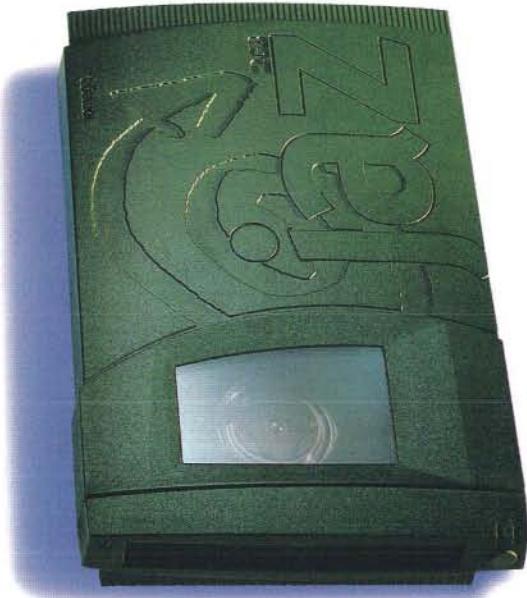
The Iomega Ditto™ family of drives is designed to protect all your important computer stuff. Whether it's the Ditto 2GB* drive, the Ditto Max drive, or the new 10GB* Ditto Max Professional drive, you'll truly have peace of mind.

Backup

Our 1-Step™ backup software makes backing up a breeze. And FullBack™ System Recovery software for Windows® or Windows NT® lets you rest easy, knowing you can bring the data from a completely lost system back from brown-outs, hard drive crashes, and those "I-swear-I-had-it-yesterday" situations.

S T O R A G E

The Iomega Jaz® drive.
The Super-Fast, Extremely Vast
Personal Storage Drive.*



Coming later this year, the Iomega Clik!™ drive.
The 40MB matchbook-size solution for
portable digital devices.



Capacity

Iomega Jaz 1GB drives and cartridges, and the upcoming 2GB drive, comfortably accommodate huge graphics, a hefty database, even rockin' A/V files. And since the disks are portable, you can take them anywhere.

Performance

The Jaz drive can rip through files. It's fast enough to store and run applications, and since Jaz disks have lots of capacity, backing up your hard drive will be even easier.

Handheld Capacity

A single 40MB Clik! disk can store approximately 40 near 35mm-quality (mega-pixel) digital photographs, or 400 10-page Microsoft® Word documents, or 25 10-page PowerPoint® presentations with graphics, or up to 4 hours of voice dictation.* Whew! That's a lot of stuff.

Possibilities

Clik! disks can make digital cameras, sub-notebooks, HPCs, projectors, cellular phones, PDAs, and global positioning systems even more functional and compatible. And who knows what other uses will be invented for Clik! disks. The future is up for grabs.

S O L U T I O N S

BUILT-IN SOLUTIONS



The Iomega Zip drive is the new standard in high-capacity removable storage.

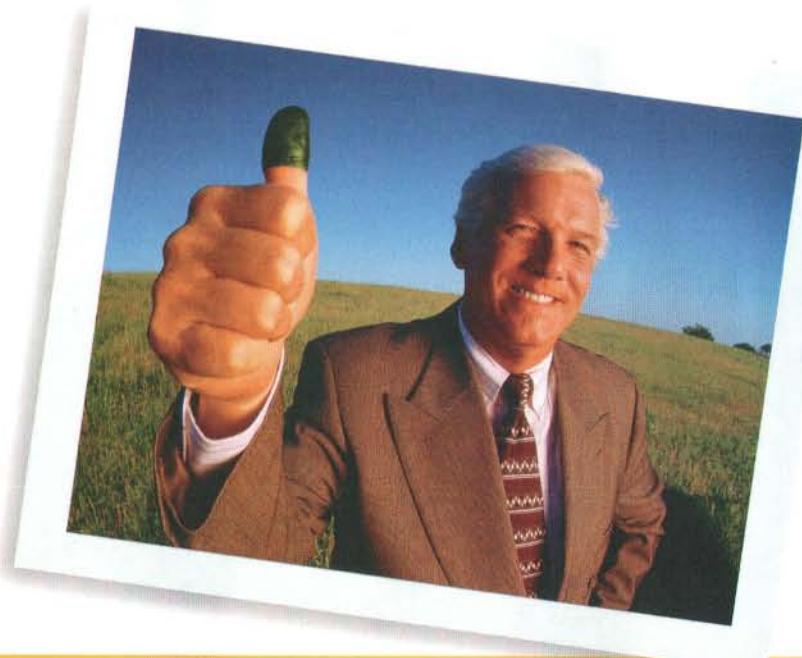
Check out these leading computer manufacturers who are building Iomega drives right into their systems.

Thumbs-up on Iomega Storage Solutions.

Finally, someone out there wants to make your job easier. Iomega has over 12 million storage solutions in offices and homes around the world. You can also look for us in service bureaus and business service centers around the country that have made Iomega the standard.

Call your corporate reseller and ask how you can organize your business with Iomega storage solutions.

Visit our Web site at:
www.iomega.com/bizsolutions



B E C A U S E I T ' S Y O U R S T U F F.™

*All cartridge capacities compressed. Compression assumes 2:1 ratio. Actual compression will vary with file and hardware configuration. Based on average-size files for these applications. Individual user results may vary. 2GB capacity where 1GB=1 billion bytes. The capacity reported by your operating system may differ, depending on the operating system reporting utility.

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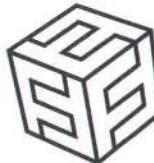
Use only genuine Zip disks featuring this symbol  in your Zip drive.



By Bob Parks



FETISH



Circarama

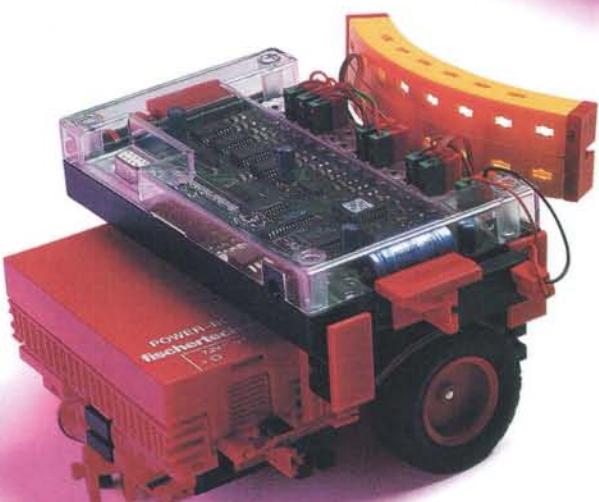
With CycloVision's ParaCamera, you can capture video in a panorama, then play it instantaneously on a PC screen. While some 360-degree camera systems shoot film one angle at a time and piece together the images later, CycloVision's camera takes continuous video with its curved mirror and unwraps images real time with the included software. For a little more dough, the company also sells server software that pushes these all-around worlds to Web pages. ParaCamera S2: US\$3,000. CycloVision Technologies: +1 (212) 499 0909.

Pugilist

Having sold more than 10 million Tamagotchis in the US alone, Bandai has taught kids much about nurturing and caring for pets. Its latest offering, DigiMon, now adds a touch of Thanatos to the previously pacifistic toy. After a few days of feeding the little monsters, kids can connect the plastic "cages" and make the virtual occupants battle. It's cooler than POGs, cleaner than cockfighting, and, most important, shows that Bandai's digital beasts can be naughty as well as nice. DigiMon: US\$15. Bandai: on the Web at www.bandai.com/.

McCoy

ThrustMaster based the design of its Millennium 3D Inceptor on an older joystick it had built for the space shuttle. Now, the gaming-hardware company and government contractor has decided to sell one – and only one – of the original NASA-bound sticks. Mind you, this is a "rotational hand controller" – not a joystick. But ThrustMaster will add a peripheral cord and base to make it ready for any old PC. Rotational hand controller: US\$10,000. ThrustMaster: +1 (503) 615 3200.



Wheelie

With a new line of racing wheelchairs and glossy ads in *Glamour*, Bob Hall is blurring the line between high-performance sports gear and tools for the physically challenged. The superlight Defiant handcycle, for instance, boasts 21 speeds, trispoke composite wheels, and a brushed-aluminum frame. Powered by adjustable cranks, the Defiant cruises at a cool 18 mph on the road — or dirt trails if you opt for mountain-bike tires. Hall, the lead designer of his company's custom-fit cycles and chairs, is well acquainted with the need for speed — he's a former Boston Marathon record holder. Defiant: US\$2,500. New Hall's Wheels: +1 (617) 628 7955.

Soho

Working in your underwear has never been so hip. In fact, marketers have dubbed the small office/home office *soho* to conjure images of the trendy Manhattan neighborhood. In this vein, Xerox makes an office machine that perfectly suits the collar-free lifestyle. The curvy and compact WorkCentre connects to a PC and offers faxing, copying, scanning, and full-color printing. Says Lunar Design's Ken Wood, who envisioned its shape, "We wanted to make it stylish as well as comfortable and intuitive, like a toaster or teapot." WorkCentre 450c: US\$499. Xerox: +1 (203) 968 3000.

Frankenstein

Fischertechnik Mobile Robots have been unleashed. For 13 years, Fischerwerke, based in Germany's Black Forest, has made snap-together robot kits — essentially Erector Sets with brains — that connect to your computer with a 3½-foot ribbon wire. Previously, you could program your bot to follow a short routine, and watch it perform on your desk. Now the robots are endowed with enough onboard RAM to store instructions. Get the 350-piece kit, assemble it, and write a program to send your invention to the kitchen and grab a snack from the fridge. Mobile Robot: US\$399. Tim King Electronics: +1 (313) 928 2598.

secure children in rear seat and obey all speed laws. For more information, visit us at www.lexus.com or call 800-USA-LEXUS (800-872-5396). Motor Trend, November 1997. "300-hp V8 available on the GS 400 model only. ©1998 Lexus, a Division of Toyota Motor Sales, U.S.A., Inc. Lexus reminds you to wear seatbelts.

LEXUS

THIS WAY COMES.

within this, the fireiest automatic sedan in the world.

SOMETHING WICKED

of the 300-horsepower, 32-valve V8, which seethes

ONE BY ONE, EACH CAR SUMBS.

the imagination, now a fixture of intimidation. All courtesy

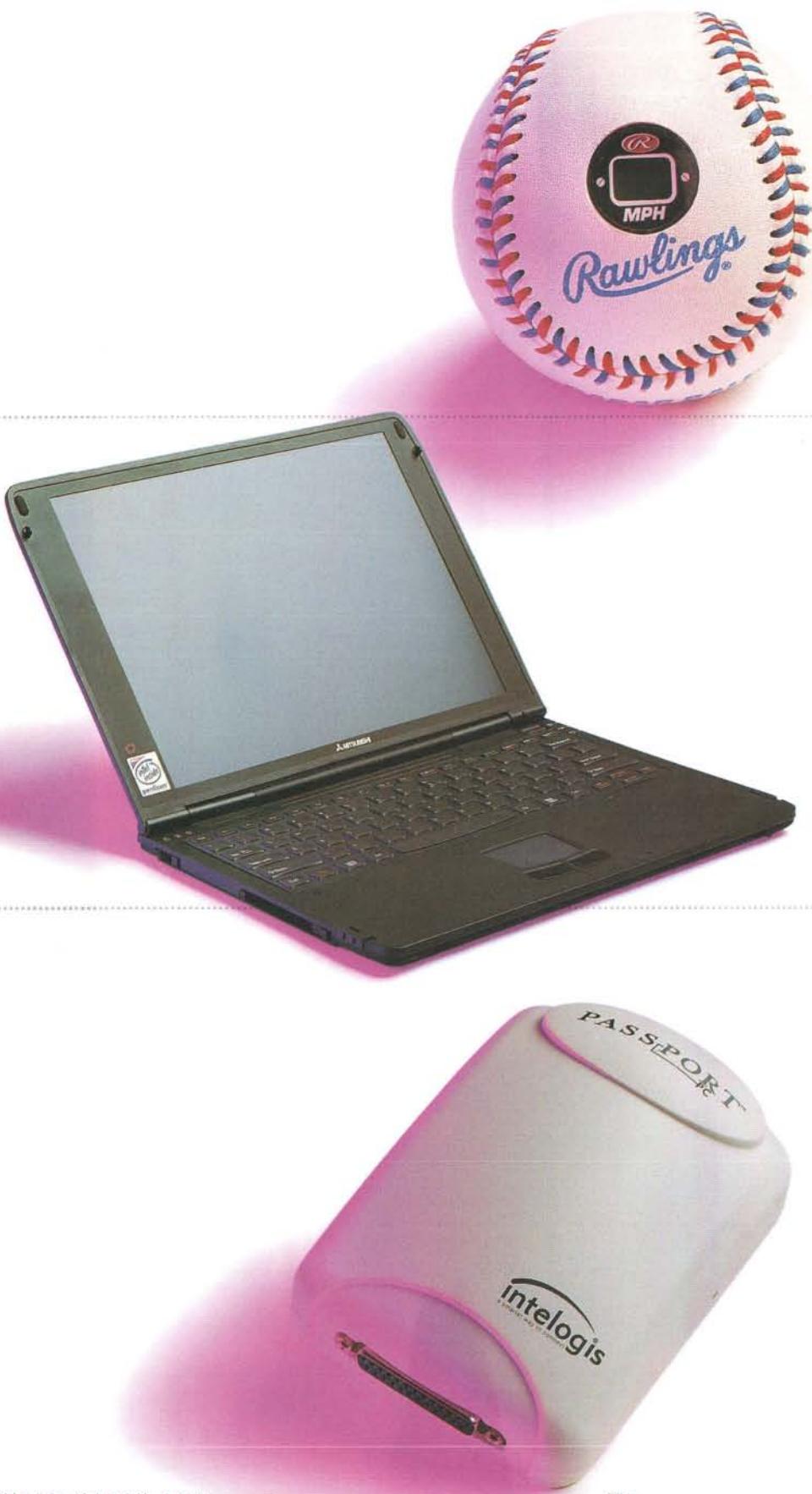
A V8 DREAMS DOWN FROM ITS THRONE.

Naught-to-sixty in 5.7 seconds! Once a fragment of

IS THAT THUNDER, GOLD AS STONE,



FASTER. SLEEKER. MEANER.
THE NEW GS



Pickle

Who is the future Cy Young Award winner on your Little League team? Rawlings's new Radar Ball will tell you. Regulation size and weight, the ball has a small LCD on its side that gives a pitcher's speed instantly. It uses an internal accelerometer to sense when the ball leaves a pitcher's hand and when it hits the catcher's glove. Speed is calculated based on the set distance from the pitcher's mound to home plate — whether you're using the 60-foot, 6-inch version for big-league ballparks or the 46-foot one for Little Leaguers. Radar Ball: US\$34.99. Rawlings: +1 (314) 349 3500, on the Web at www.rawlings.com/.

Thin Client

Mitsubishi's Pedion has a slender profile but packs a punch. This silvery box is a miraculous seven-tenths of an inch thick and weighs 3.1 pounds. Even more miraculously, its 233-MHz processor and 32 megs of RAM keep pace with everything else on the road. The unit's battery life disappoints, but the larger-than-average keyboard does eliminate one major problem with today's tiny computers: keys so small you have to hire a child to type for you. Pedion: less than US\$6,000. Mitsubishi Electronics America: +1 (714) 220 2500.

Grid

Recent experiments in the UK to send data through electric-power lines show that the technology still has a few kinks to work out. In the meantime, you can use the same idea to set up a local-area network in your house. By transmitting data over 110-volt electrical wires and using plain old outlets as ports, the Passport system links PCs around the house at data rates as high as 350 Kbps. The setup works a little slower if you activate the encryption option — but at least you won't have to worry about blasting private emails across the neighborhood power lines. Passport: US\$249.99. Intelogis: +1 (801) 756 5199.

Thanks to Jacob Ward.



From the most prescribed name in the history of pain relief, Motrin® Prescription Proven Power. Motrin IB. Nothing's proven more powerful on headache and muscle pain. Yet it's gentler on your stomach than aspirin.

Motrin® Spoken here.

**Motrin® Prescription
Proven Power**

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Use only as directed.

You're looking to stash some cash, fast.

The tax-deferred kind. So you're shopping for a retirement account. IRA, Roth IRA, 401k, whatever.

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HDTV Rebel

Twelve years after founding one of the first high-definition production houses, Barry Rebo emerges as a leader of the suddenly fast-growing field.

At January's International Consumer Electronics Show in Las Vegas, brand-new HDTV sets were everywhere, fed by a continuous stream of high-definition television programming from the three big names in high definition: CBS, PBS, and ... Rebo Studio. With its 125 hours of long-form HD programming, Rebo Studio - a 12-person production house in Manhattan founded by Barry Rebo - is ostensibly the biggest producer of HD programming in the US, from commercials and music videos to *Wild Life Adventures* for Turner Original Programming and the documentary *A Passage to Vietnam*.

Rebo and his loyal cadre of HD enthusiasts have been producing HDTV programming since 1986, at a time when most Americans hadn't even heard of NTSC, the current broadcast standard. But Rebo has been ahead of the curve his entire video career, accumulating what he calls "a healthy record of firsts," starting with dropping out of Stanford University's graduate film school and flying to Japan to buy the first-ever portable color video equipment. He launched Rebo Associates in 1975, dedicated to "film-style" video storytelling.

Like many a video storyteller, Rebo had the bug to tell stories in celluloid. So, in 1986, when he saw the astonishing imagery of an HDTV program transferred to 35-mm film, he thought it so "revolutionary" that he plunked down US\$1.5 million for the first Sony HD camera and editing packages sold in the US.

"I've never wavered from my belief that high-definition TV will be a big part of the imaging industry," says Rebo. "I just didn't foresee the politics and dramatic changes in technology."

Those technopolitical debates stalled HDTV for nearly 10 years - from 1987 to 1996 - but Rebo kept the faith through those difficult, often lean times. In fact, it was a productive period at Rebo Studio. His technical gurus Barry Minnerly and Abby Levine created ReStore, which

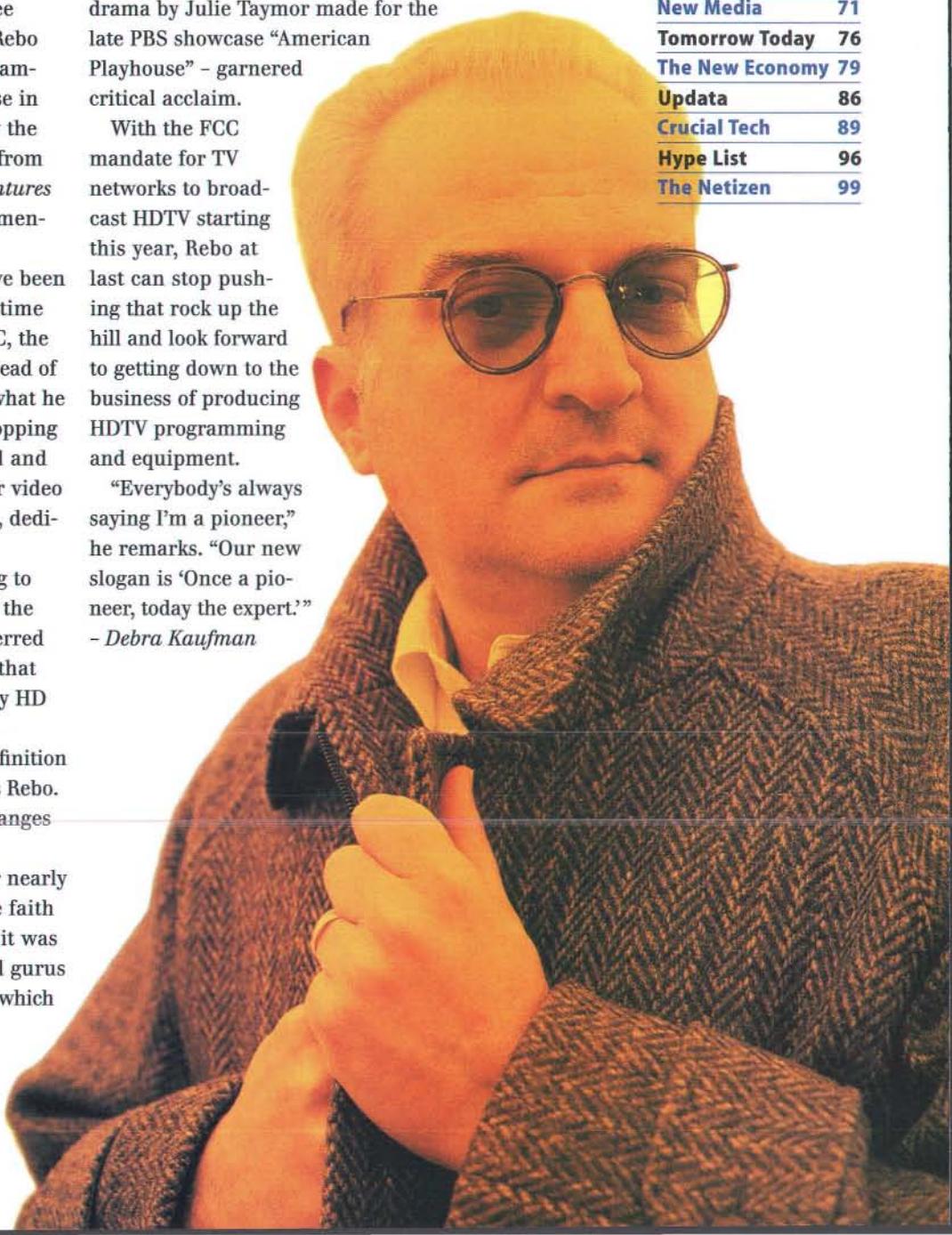
enables any Macintosh imaging software to run in HD, while his studio kept churning out HDTV programs, some of which - like *Fool's Fire*, a puppet fantasy-drama by Julie Taymor made for the late PBS showcase "American Playhouse" - garnered critical acclaim.

With the FCC mandate for TV networks to broadcast HDTV starting this year, Rebo at last can stop pushing that rock up the hill and look forward to getting down to the business of producing HDTV programming and equipment.

"Everybody's always saying I'm a pioneer," he remarks. "Our new slogan is 'Once a pioneer, today the expert.'"

- Debra Kaufman

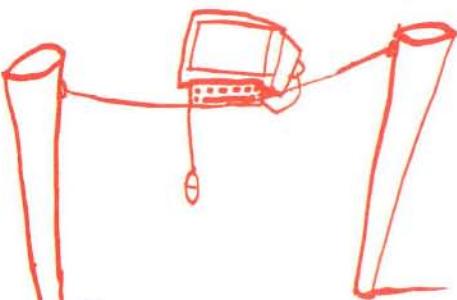
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Rebo's studio:
from pioneer
to powerhouse.

ITV: Why Cable Is Lining Up for Another Potential Beating

Three years after interactive television fizzled into vaporware, the cable industry is at it again. Executives are talking tough. Equipment makers are bullish. Bill Gates and other cybergeeks are pushing software and operating systems. Even TCI chair John



Malone, who prematurely predicted a "500-channel universe," is talking up a storm. "I haven't been this excited since Universal gave us *Jaws* on HBO," Malone recently proclaimed.

Why does the cable industry now appear ready for another potential beating? The answer is one of economics, better technology, and the Internet.

On the economic front, digital converters that once cost thousands are now a few hundred dollars. In December, TCI inked a multibillion-dollar deal with General Instrument for up to 12 million boxes. GI then turned around and agreed to sell a US\$187.5 million chunk of itself to Sony. Meanwhile, the

industry's research arm, CableLabs, is establishing a set-top standard, further driving down prices.

In terms of technology, the options have diversified – from simplistic software that pumps data through the TV's vertical blanking interval to network computers that offer video email. Companies like WorldGate, Interactive Channel, and Wink Communications – as well as behemoths like Microsoft, Sun, and Oracle – are making hard sells.

And then there's the Internet. TCI, Cox, and Comcast have partnered with @Home Network, an Internet cable-modem company. Time Warner and @Home rival MediaOne have joined forces. And don't forget Microsoft, whose \$1 billion investment in Comcast warmed Wall Street to broadband cable.

The cable guys also want some of the electronic commerce pie. Malone and others talk of ordering pizza, linking to advertisers' Web pages – all with the click of a remote.

So, cable optimists argue, a lot has changed since the last run at interactivity. Now they're just hoping that the best thing since *Jaws* doesn't eat them for lunch – again. Duh-dum duh-dum. – Michael Grebb

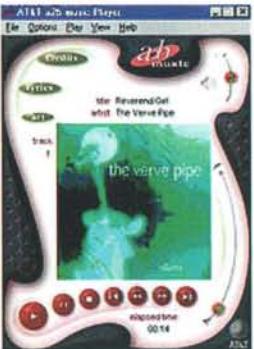
a2b or Not to Be?

Last year music pirates took to the Web in droves to download MP3-compressed CD-quality singles for free. This state of affairs kept most record companies out of cyberspace. The few that did venture online found themselves mired in lawsuits against online bandits.

Now AT&T has stepped in with a spin-off company, a2b music, that pairs compression algorithms and encryption technologies to offer sterling-quality singles over the Net. For speedy delivery, the collectibles are 50 percent smaller than normal audio files.

a2b appears to be successfully treading the tightrope between consumers, artists, promoters, and retailers. Its security features protect against theft while allowing flexible licensing such as single, multiple,

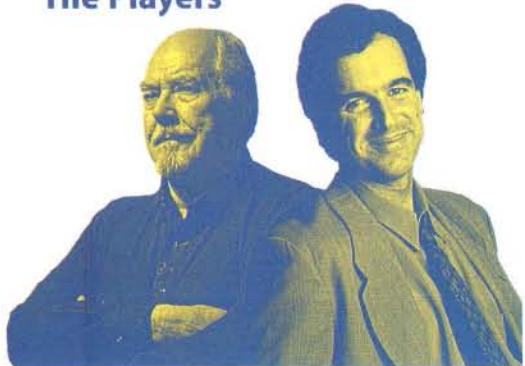
or shared uses of files. Customers pay a small fee – usually a dollar or less each – for these musical gum balls.



So far, an impressive collection of record companies have flocked to the service, including Transworld, N2K, Camelot Music stores, and BMG Entertainment, the US\$6.3 billion distributor of Arista, RCA, and Windham Hill labels. Most important, a2b has attracted a long roster of artists. "We're not trying to dictate to the industry," notes CTO Howie Singer. "But it's our intention to make this work for everybody."

The Net may be a hot new distribution method for music, but the payoff for record companies will come with bulk shoppers. After a singles trial, several labels plan to launch full Web CD releases. – Colin Berry

The Players



Paired once again with the sharp-witted Garry Trudeau (right) of *Doonesbury* fame, Robert Altman is turning his discerning lens on the high tech industry. The last time these two teamed up was to create the HBO mini-series *Tanner 88*, an acclaimed and edgy chronicle of a fictional presidential campaign. Their latest small-screen venture, *Killer App*, includes a "colorful cast of characters, with Silicon Valley as the backdrop," says Andrew Steinberg of the production firm Kushner-Locke. The live-action, one-hour weekly series is in early stages of development and may air on ABC this fall. – Jennifer Hillner

The Blind New Science of Making Babies

By Jon Katz

For a revealing look at the American media's schizophrenic and dysfunctional relationship with technology, as well as morality and medical ethics, we need go no further than the ongoing celebration in Carlisle, Iowa.

The November hoopla over the birth of the McCaughey septuplets is nothing compared with what's to come: The family's move into their new, community-funded home. Free trips to Disneyland and Sea World. The seps going to school, falling in love, getting married, going to college and - to be witnessed by those of us still alive - making child-rearing decisions of their own.

The dramatic demonstration of the new power of medical technology has been enthusiastically embraced by corporate and political America, and by journalism, the pliant cousin of both.

The McCaugheys appeared on *Dateline* chatting with Jane Pauley and on *ABC World News Tonight* accepting the keys to a donated new van, as well as on

the cover of *Newsweek*, where Kenny and Bobbi - the latter's teeth digitally enhanced, the red-faced magazine later admitted - announced "We're Trusting in God."

They'll need him, too, now that they've brought into the world seven babies they can't possibly care for themselves - he's a clerk at a car dealership, she's a seamstress.

The United States has odd ethical concerns about technology. Let Johnny log on to the Playboy Web site, and moral watchdogs turn out in force. Let a real thorny issue surface - cloning, genetic engineering, powerful fertility drugs - and there's hardly a guardian in sight.

Right here, on our nightly newscasts, on magazine covers and newspaper front pages - and in the thoughtless way they're marketed - reckless decisions are mindlessly endorsed by everyone from the president down to the headline writer and presented in simplistic, emotionally manipulative ways.

Who, after all, wants to be critical of cute little

babies fighting for their lives, or of the deeply religious mother who gave birth to them at the will of no less an authority than God himself?

But who speaks for preemies like these in the age of multiplying multiple births? Medical ethicists warn us in vain of the implications of fertility drugs, artificial insemination, surrogate parenting, genetic screening, and cloning.

Child-development experts say that having four, five, or six siblings the same age raises all sorts of psychological and developmental challenges. Fertility specialists warn, on those few occasions when they're asked, that the parents of multiple children are rolling dice with their children's lives. If they lose, they could be taking home children with severe deformities.

Problems of premature infants, warned one Massachusetts General Hospital neonatologist, include chronic lung disease, blindness, stroke, cerebral palsy, and long-term learning disabilities. According to experts, for seven normal babies who survive the concern is not so much what is likely to happen as what isn't.

In the era of HMOs, expensive, complex fertilization and implantation procedures are increasingly available to the poorly insured and the poor, who may not be able to afford basic care and routine medical procedures for multiple children. Meanwhile, millions of dollars are poured into this "brave new science" of making babies.

Media coverage of this artificial business leaves elemental questions unresolved. How far can we - should we - go to make babies? Who weighs the cost of this babymaking and baby rearing against the need to attend to more pressing medical matters? Who is responsible for raising and caring for the record number of babies - sure to increase - we can now make?

In the context of the McCaugheys' lives - their religious background and their close-knit, all-American community - we were presented with a happy miracle.

But it might not have been one. In modern-day America, we have so far opted to let technology decide moral issues for itself. ■ ■ ■



In the age of high tech babymaking, preemies are in search of a spokesperson.

Email Jon Katz at jonkatz@bellatlantic.net.

Postmodern Muse

Ask Wally Brill to identify his musical spiritual center, and he's as likely to point to Miles Davis or Johnny Cash as Salif Keita. Before producing records for such artists as Thomas Dolby and 999, Brill grew up in a "secular" New York household. Ironic, then, that Brill's discovery in a friend's attic of a stack of 78s - discs featuring Jewish liturgical singers from the 1920s to the '50s - has resulted in *The Covenant*, a most spiritual, and controversial, pop CD.

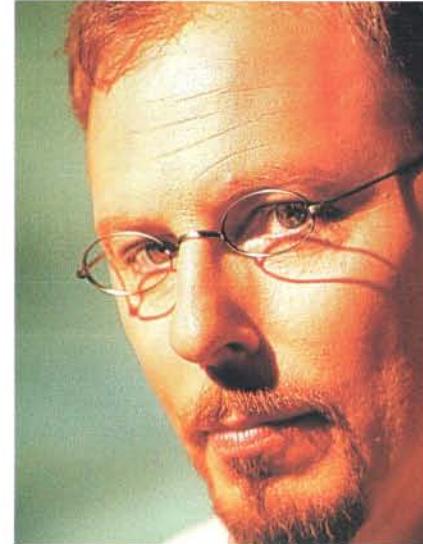
Recorded from the 78s and transferred into electronic files, songs feature cantors Pierre Pinchik, Samuel Malavsky, and others, their *hazzanut* delivered with divinity and soaring praise. Loops of indigenous percussion and vocals surge to an electronic beat. Though its words are undeniably Hebrew, the disc savors musical styles associated with Muslim and Buddhist faiths and stirs in some New Age philosophy and native rhythms. Temple cantors once sang in opera halls, Brill explains, but now he

is delivering them - via digital media and aboriginal instrumentation - to a contemporary audience.

Surprisingly, Brill's loudest critics are old-school Jewish cantors. Some contemporary cantors have labeled his smorgasbord "primitive"; others have simply suggested he not mess with the past. "I get a lot of criticism because I use Deepak Chopra on the record," says Brill between bites of bagel, "but he's got a lot to say - namely that we're in a realm of all possibilities and have the power to bring things into being."

Brill claims to find divinity in all sounds. "All music is spiritual - even the Spice Girls," Brill grins, "though for me, they don't speak as divinely as Nusrat Fateh Ali Khan."

- Colin Berry



IMAGES (CLOCKWISE FROM TOP): CHRISTINE ALICINO; LOU BEACH; PAULA LUKEY



At Computer Film Company in Culver City, California, DreamWorks SKG producers eye digital effects for the upcoming feature *Paulie* on a monitor and discuss changes with the artists. Just a typical day in Hollywood - except that the images and the digital artists creating them are nearly 6,000 miles away in London.

What makes this long distance creative collaboration possible is Sohonet, a digital pipeline between the two far-flung cities that just opened for transatlantic business.

Digital networking is nothing new, but until now it's been the sole domain of big-budget filmmakers. Sohonet makes it as easy and routine as a phone call. According to managing director Neil Harris, Sohonet is the brainchild of staff at digital-effects and postproduction facilities clustered in London's media-hot Soho neighborhood. Four years ago,

ATM was an untried technology in the film business, but in late 1995 five companies hooked up to give it a try. Once united, Sohonet turned its sights to Hollywood. "For Hollywood studios that have offices in London," says William Sargent, executive director of Megalomedia, "Sohonet is the potential umbilical cord."

For now, only transatlantic Cinesite and Computer Film are able to easily use the service. Future network upgrades will support videoconferencing, higher-resolution files, and a direct connection to major US studios, ad agencies, and production companies.

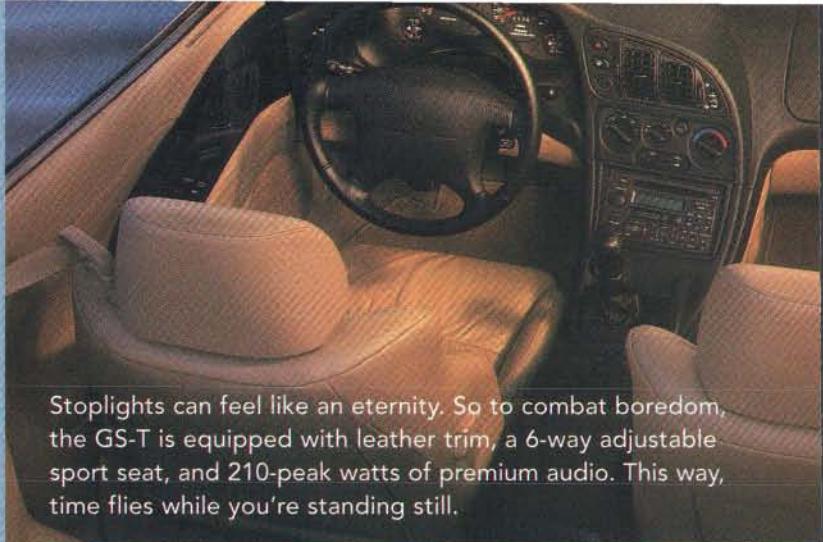
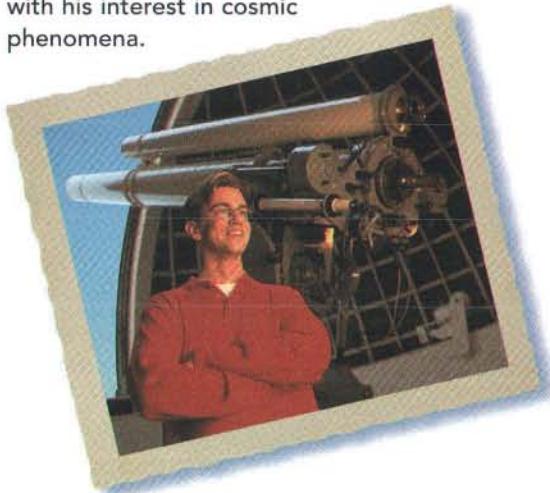
"There's not enough capacity in LA to satisfy the huge appetite for effects work," reveals Harris. "We hope to help take away some of the strain." - Debra Kaufman



The City Is an Advertisement

Two of the newest frontiers of advertising take advantage of captive audiences: consumers at the gas pump and the cash machine. Electronic Data Systems has begun testing 15-second spots on 150-plus ATMs in the San Diego area. Rio Network of Raleigh, North Carolina, beams ads to US gas pumps via satellite. While pump ads are limited mostly to LCD readouts, EDS goes higher tech at ATMs, with full-color video ads and movie clips. Do consumers mind the intrusion? Rio's Dick Diemer says no, so long as it's brief. After all, he adds, "people don't like to stop for gas in the first place." - Chris Rubin

Tell David Hansen he has his head in the stars and he won't take offense. You see, David's an astronomy buff, and even his choice of car was influenced by celestial bodies. David drives a turbocharged, 210-horsepower* Eclipse Spyder GS-T, which aligns perfectly with his interest in cosmic phenomena.



Stoplights can feel like an eternity. So to combat boredom, the GS-T is equipped with leather trim, a 6-way adjustable sport seat, and 210-peak watts of premium audio. This way, time flies while you're standing still.

Okay, so the hat's history. No problem. Just hold a button for ten seconds and you have shade. High-quality, power-operated, fully-lined, cloth-covered shade. Now hit the accelerator and watch all the other cars disappear in the glass rear window.



Place hat on head. Press accelerator.

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Eclipse Spyder GS starts at \$21,430. Eclipse Spyder GS-T shown MSRP \$26,660 plus \$420 destination/handling (Alaska \$540). Excludes tax, title, license, registration fee, dealer options and charges. Prices and vehicle availability may vary. Actual prices set by dealers. *205 hp with automatic transmission.



We take fun seriously. Which means the Eclipse Spyder has some serious engineering. Starting with a reinforced chassis and a suspension that's engineered specifically for this convertible. You see, the only thing we want rocking and rolling in our car is the stereo. For more details on the Eclipse Spyder, call 1-800-55MITSU. Or cruise by our web site at www.mitsucars.com

Spring 1998

Restart Me Up

Freshly minted Windows 98 CDs are shrink-wrapped and shipped to the far reaches of the planet – just in the nick of time. Explorer is finally an OS element, despite the protestations of federal antitrust prosecutors. The browserish interface, and support for DVD hardware – plus the Universal Serial Bus – drives sales past the 50 million Win95 units sold. The kickoff song: another Rolling Stones golden oldie, "You Can't Always Get What You Want."

Summer 1998

Writing to Disc

Computers equipped with DVD-RAM drives arrive on Costco shelves, but the débüt is less than auspicious. Costly capture boards are required for recording video, so the 5.2-Gbyte discs will be used for the less exciting task of backing up data – lots and lots of data. And Sony's commitment to an alternate RAM standard, DVD+RW, leaves consumers confused. No matter; the potential for new markets (read: porn) sparks retail demand for recordable DVD players.

Fall 1998

Aquatic Rocket

Boeing's Sea Launch, a 660-foot-long command ship that controls a 30,000-ton oil rig turned launchpad, hauls a rocket out to sea and fires off a satellite from the middle of the Pacific Ocean. The inquisitive might wonder, why all the fuss? It seems aquatic, near-equatorial launches best utilize Earth's rotational forces – saving fuel, ensuring a longer life in orbit, and allowing companies to shoot ever-larger satellites into space.

Spring 1999

Beer-Bottle Boon

Barroom brawlers find themselves in a quandary when Superex Polymer releases technology to manufacture airtight plastic bottles. Beer bottlers have had to rely on glass because plastic allows oxygen to leak in. Superex has found a way to make an air-resistant liquid-crystal polymer – the thick plastic used for electrical connectors – thin enough to be placed inside a bottle. The lightweight plastic spells cheaper beer (mmm ... cheap beer) and wild new packaging.

2000

Intranet of Intranets

Nasdaq completes its Enterprise Wide Network II. The new net supports trading on the magnitude of 4 billion shares a day, scalable to 8 billion shares, and proves to be the world's largest and fastest intranet. Quite an impressive feat, unless you consider that on October 28, 1997, total market transactions numbered a record 1.37 billion, causing network operators to wonder how many trades a panic – er, correction – can engender.

1998

01 02 03 04 05 06 07 08 09 10 11 12

2001

01 02 03 04 05 06 07 08 09 10 11 12

2002

Spring 1998

Matinee Mayhem

A year after Tamagotchi's rampaged through schools like Game Boys on juice, a remake of *Godzilla* sets Hollywood on fire. Once again, Japanese pop culture lands on the Main Street marquee – albeit 44 years after the original movie's premiere. Toho, the Japanese distribution company that owns the rights to the film, has long protected *Godzilla* more vigilantly than Coca-Cola guards Coke™. But thanks to the prying ways of TriStar Pictures, moviegoers finally revisit the wonders of *Monster Island*.

Fall 1998

Internet Throwback

The completed Internet2 wires 116 universities to a new high-performance network. After starting with a paltry 34 sites back in 1996, the finished project harks back to the early academic days of the now commercialized Net. Nostalgia aside, Internet2 heralds cutting-edge advances – such as bandwidth-reservation services, support for IPv6, and an architecture built around gigaPOPs (gigabit-capacity points of presence) – that should eventually seep into commercial networks.

Fall 1998

Nova Scotia Cares

Canada's first provincewide telemedicine network, the Nova Scotia TeleHealth Network, holds the distinction of being one of the largest public-health communications projects in the world and the first to connect every hospital (43 sites) in an entire jurisdiction. In human terms, rural doctors from the eastern regions can send X rays of fishing injuries to radiologists in Halifax, while MDs across the land share expertise and images to pin down vexing diagnoses.

Fall 1999

New Dune

Bantam Books's US\$1 million investment in a trilogy of *Dune* prequels – coauthored by Frank Herbert's son, Brian, and SF author Kevin Anderson – comes out just in time for holiday shoppers. Fans compare the new offering to the original series, hoping that Junior has managed to capture the majesty of Senior's vision instead of the campy cult status of the film version starring Sting. Either way, considering that the original *Dune* sold nearly 10 million copies, the publisher is the biggest winner.

2001

Mario's Cap and Gown

Students at DigiPen, the videogame institution of higher education, take the long walk to the real world when the so-called Donkey Kong U. doles out the world's first bachelor of science degree in real-time interactive simulation. During the previous four years, pupils in the maiden class have studied mathematics, physics, programming, and animation. Now, equipped with little more than that coursework and the idealism endemic to recent grads, they leave the warm nest of college for the cold, hard realities of the gaming industry.



AIRWALK

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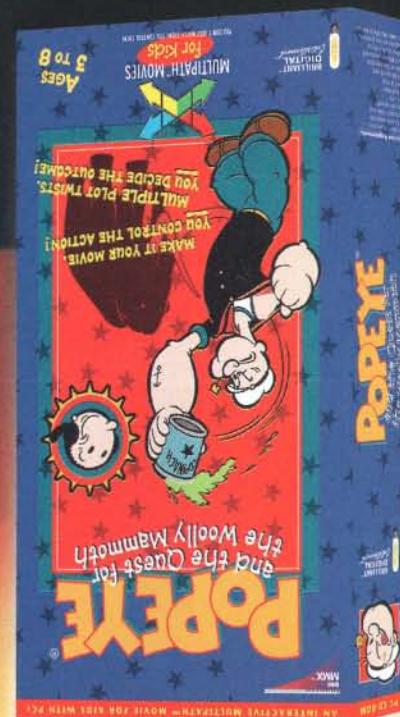
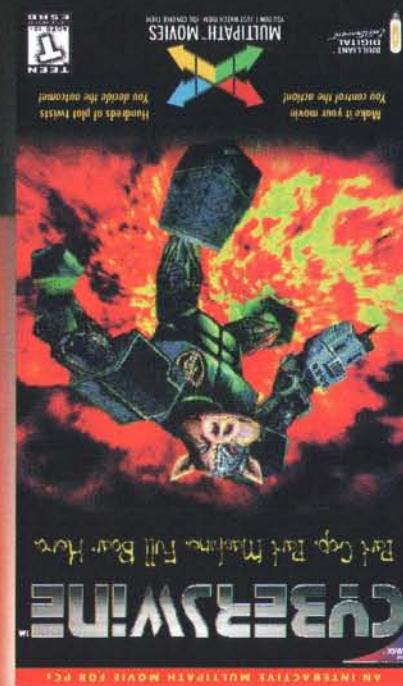
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China,

THE NEW ECONOMY

E

Big Time

Don Xia's ChinaBiG appears to have an advantage any monopoly would envy: the government's blessing. But some see this blessing as decidedly mixed.

On first pass, ChinaBiG (www.chinabig.com/) faces the same huge expectations and slim chances of any online start-up. Sure, the Hong Kong-based company boasts an impressive 2 million business listings in its Yellow Pages-style directory, and, true, they're bilingual (Chinese and English), offering Chinese businesses access to foreign markets, and vice versa. But ChinaBiG relies on typical Web revenue streams such as advertising and site hosting, and as the 91 online directories that failed in the fourth quarter of 1997 can tell you, these streams aren't flowing like they should.

And yet, for a start-up, ChinaBiG appears to have an advantage even Bill Gates might envy: a monopoly, the blessing of the Chinese government, and its own infrastructure. The venture is one of the first new media companies launched by China Unicom. In the early '90s, a combination of state and private funding led to the creation of Unicom, which the 35-year-old CEO of ChinaBiG, Don Xia, claims has the lead in building the next generation of long distance backbone networks - via fiber optics, microwave, and satellites - that will transmit the Internet telephony, faxes, and wireless communications essential to doing business overseas.

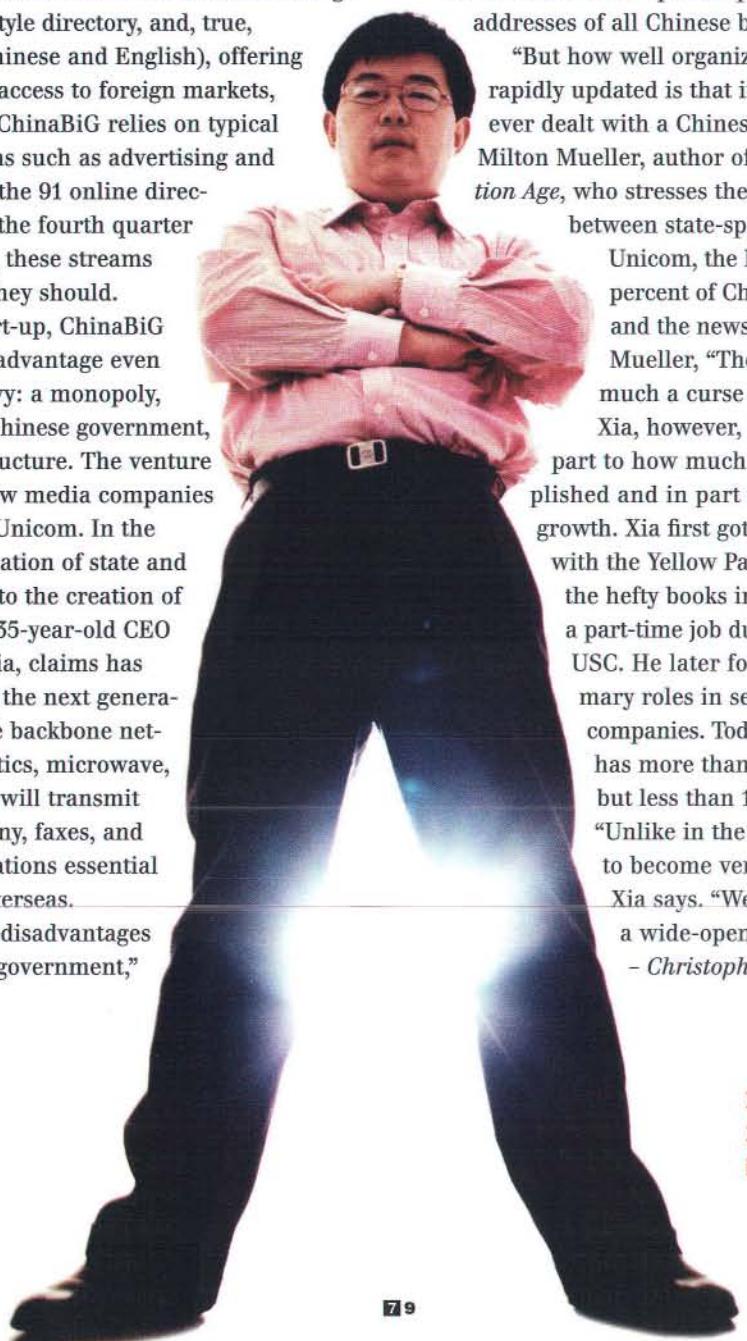
"I don't see many disadvantages to our ties with the government,"

Xia says. "But the advantages are many." Among them, a shared monopoly with the Ministry of Posts and Telecommunications on the government's business listings, which include the updated phone, fax, and street addresses of all Chinese businesses.

"But how well organized and accurate and rapidly updated is that information? Have you ever dealt with a Chinese bureaucracy?" asks Milton Mueller, author of *China in the Information Age*, who stresses the "vicious" competition between state-sponsored enterprises like

Unicom, the MPT (which claims 98 percent of China's telephone market), and the news agency Xinhua. Says Mueller, "The state connection is as much a curse as it is an advantage." Xia, however, is optimistic, owing in part to how much he's already accomplished and in part to the potential for growth. Xia first got hands-on experience with the Yellow Pages when he delivered the hefty books in the Los Angeles area, a part-time job during graduate school at USC. He later founded and played primary roles in several Chinese telecom companies. Today, Xia points out, China has more than a billion consumers but less than 10,000 active Web sites. "Unlike in the States, where you have to become very specialized and fast," Xia says. "We see online business as a wide-open opportunity."

- Christopher Jones



Xia's ChinaBiG boasts
2 million business listings
in the Greater China region.

Esther Dyson in Poland

Just as EDventure Holdings chair Esther Dyson has made her mark stateside as a consummate networker and author, her reputation precedes her in Central Europe, where she's helped fledgling entrepreneurs become market leaders. What's not yet clear, however, is whether Dyson can apply her magic to her own Central European businesses.

Though she owns and manages minor investments in Hungary and the Czech Republic, Dyson has invested most heavily in Poland, which she finds "the most appealing" because in this country of 40 million, business is growing fast and "they all need better systems."

In 1994 she used US\$50,000 to help launch an Internet service provider, Poland OnLine (aka Polska OnLine). By mid-1997 it had 50 employees and 2,200 subscribers, including 500 businesses. The 1996 revenue, however, was a meager \$165,000. She raised more money for Polska throughout '96, securing a capital infusion from Dan Lynch at CyberCash, among others. (The total cap, she says, is nearing \$800,000.)



She also emphasized custom software development, merging Polska with Buk BT.

"The goal is to expand rapidly, but carefully," Dyson asserts. "We have strong programmers, and we want to become an important force in the software-development market."

Ask around in Poland and it's plain that Dyson is held in high regard, owing in large measure to the annual East-West High-Tech Forum, held first in Budapest in 1990. "Her role was tremendous," says Bogdan Wisniewski, vice president of Warsaw-based ComputerLand. "Esther helped us know the future and accommodate to that." Today, as a ComputerLand board member, "she is on the telephone, listening." In contrast, Wisniewski says, US partners previously "came to us, tried to show us how to do business, but didn't listen. Esther was different. She was trying first to understand what the rules were here, what were the differences."

Though obviously appreciative of her efforts, Wisniewski hesitates to say whether Dyson's companies will prosper. Polska Online executive Slawomir Kulagowski is convinced that they will. While Polish business chiefs sweat this year's IT demands, Kulagowski says, "Esther's horizons start after five years."

—Peggy Simpson

Canadian High Tech Tax Dodge



Residents of Quebec recently learned that some of their local restaurateurs are on the tax-evasion vanguard. Someone hacked a Gamma MicroSystems software program most Canadian hotels and restaurants use to tally and report sales tax, allowing the restaurant owners to underreport their earnings and deny the government millions. Revenue Canada, the government's tax-collecting arm, has responded with a tech-enhanced investigation. As government spokesperson Michel Cleroux told Toronto's *Globe and Mail*, "We have computers, too."

—Bill Brazell

Watching the Predictors

While we know that ecommerce keeps growing, by how much is anyone's guess. And analysts don't make matters any easier. Their estimates for United States online sales in 2000 differ by as much as US\$61 billion, and not only that, their estimates of actual ecommerce revenues in 1996 don't mesh, either. (See chart at right.)

Why the vast disparity? For starters, there's little consensus about what ecommerce measures. And each company uses a slightly different model to make its forecasts. Most conduct a survey: IDC talks to 40,000 Net users, Dataquest interviews 5,000 online shoppers, and Jupiter and Forrester question Web merchants. Revenues are then derived using a variety of

methods that include guesstimating growth based on assessments of current Web-user behavior (IDC), contrasting numbers with secondary ecommerce research from ACNielsen and CommerceNet (Dataquest), comparing estimates with hard numbers gathered from major online retailers (Forrester), or projecting ecommerce growth as a portion of total online audience (Jupiter).

The good news: all four research companies report underestimating their 1996 figures. The bad news: none have developed a way to forecast without resorting to old over-the-counter sales models, even though ecommerce obviously eliminates the counter.

—Michael Behar

Ecommerce Revenues (US\$ billions)		
Source	1996	2000
IDC Research	\$2.2	\$94
Forrester Research	\$1.4	\$117
Jupiter Communications	\$0.7	\$15.6
Dataquest	\$6.4	\$56

High Tech Embraces “Offshore” Employees

E

Contrary to the views of Congress, presidential hopefuls, and Ross Perot's Reform Party, Silicon Valley sees offshore programming as a win-win strategy. Here's why. By David Case

Despite a few hardships, like the time his motherboard crashed and he had to drive 600 miles to Moscow for a replacement that failed too, software programmer Alexander Polusko's career illustrates how almost anyone anywhere with a computer and the right programming languages can tap into the network economy.

From his home in distant Tolyatti, Russia, Polusko makes a handsome living punching code for Access Softtek, a Berkeley, California, firm with clients such as Microsoft and Adobe. And Access CEO Chris Doner couldn't be happier with Polusko and his peers, pointing out how easy it was

for Access to establish overseas operations. There were no huge capital investments, no shipping nightmares, and none of the usual bureaucratic tangles that encumber traditional foreign ventures. Plus his Russian programmers often get by without an office.

Sound encouraging? Not to Russell Verney, chair of the Dallas-based Reform Party.

To Verney, Polusko represents

“a threat to the American lifestyle.” According to Verney, “Engineers in the US can't compete with programmers in countries like Bangladesh, who work for a minimum of 60 percent less pay.” And it's not only Ross Perot's cronies who fret over giant sucking sounds: for similar reasons, several in the House opposed granting President Clinton fast-track trade-negotiating status late last year.

Talk to managers and software engineers in Silicon Valley and you'll soon learn that these neoprotectionists don't speak for them. To software and multimedia firms in particular, overseas, or “offshore,” labor holds great promise, a win-win situation that enriches both American and foreign workers – and benefits consumers to boot. Globalization, they contend, creates opportunities for products that would be too expensive to make in the US alone, while also increasing productivity. Abroad, they say, outsourcing bolsters wages and encourages higher education. Moreover, it makes sense. Despite the two-thirds global market share

held by American software companies, only one-third of the world's estimated 6 million programmers actually live in the US, and studies released this January confirmed what leading software companies already knew: there's a shortage of skilled IT workers. Last year only 26,000 computer science graduates matriculated from US universities, and the US Department of Commerce has reported that 1 in 10 infotech jobs lacks a warm geek.

No wonder, then, that entrepreneur Jas Dhillon went to India. He did so not to save money – the cost differences have become negligible, he says – but because he was unable to attract employees in Silicon Valley, even when offering six-figure salaries. Using code written in Bangalore, he has launched Blue-Line/On-Line, a service that enables construction projects to be managed over the Net.

Morgan Interactive, a multimedia firm, moved most of its operations to Vietnam, where it now employs about 120 artists and programmers. There, the firm reduced its costs by a staggering 70 percent – as a result, says Morgan president Ed Dua, he's hiring again in San Francisco.

Perhaps most important, high tech employment departs from the low-wage manual work US businesses have historically foisted on contractors in developing nations. It encourages higher education – and sometimes pays for it. Last year Oracle trained about 200,000 students abroad, and the firm plans to spend \$50 million to train thousands more this year. Yes, this is hardly altruism (Oracle will expand its market by having users abroad), but Oracle's programs definitely defy the conditions of textile sweatshops.

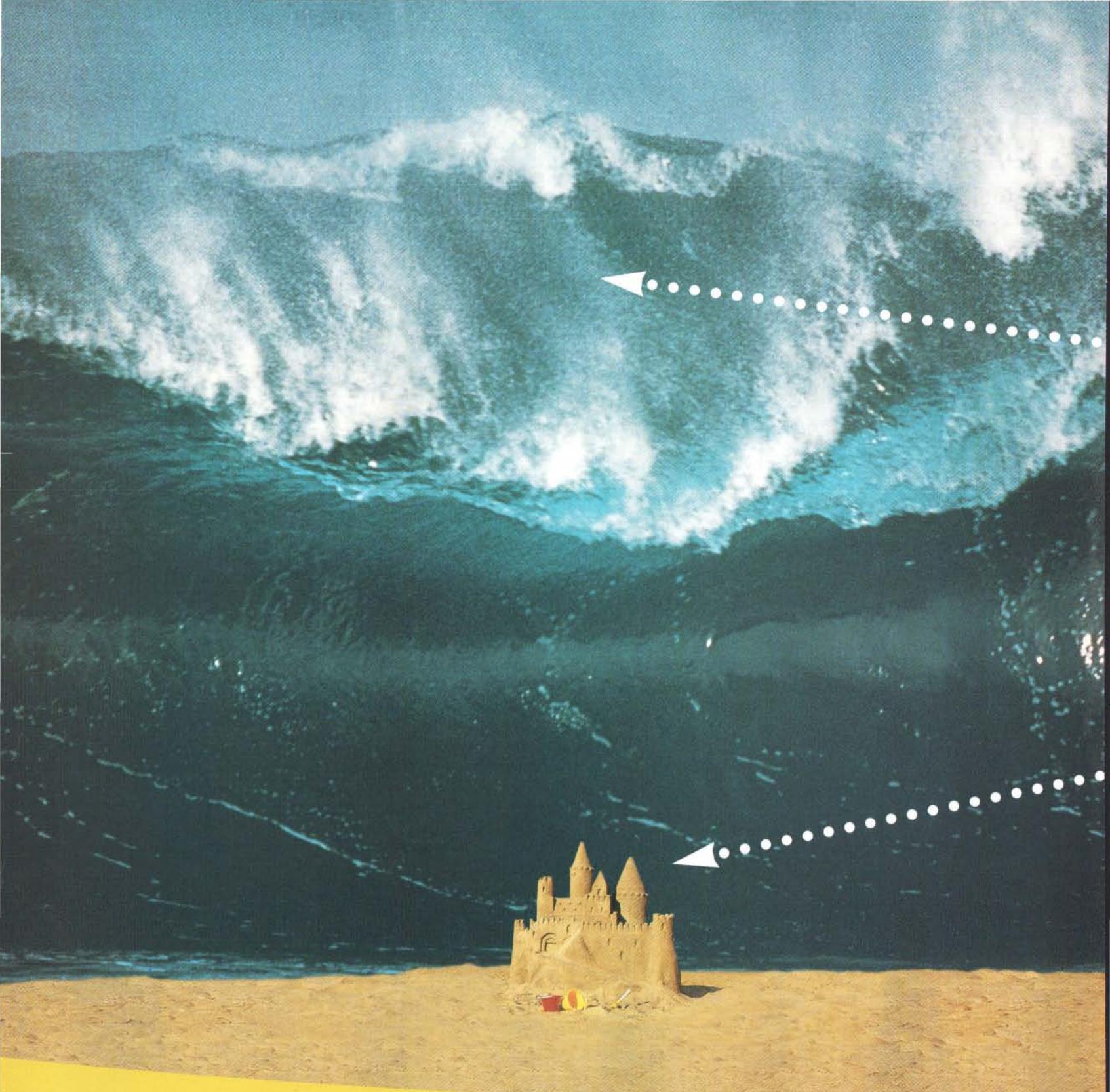
Even The Institute of Electrical and Electronics Engineers (representing nearly 100,000 computer professionals) disagrees with attempts to shackle the international labor market. “We've come to the conclusion that monopolies – either in terms of companies or countries – don't lead to growth,” says Paul Kostek, president-elect of IEEE-USA. “The competition is actually very good,” he concludes. “It keeps us on our toes.” ■ ■ ■

Despite the two-thirds global market share US software companies hold, only one-third of the world's programmers live in the US. No wonder businesses look abroad.



Silicon Valley leaders don't fear jobs flying overseas. In fact, they often have to leave the country themselves to find qualified employees. Last year there were just 26,000 computer science grads in the United States.

David Case (maleta@compuserve.com) is a San Francisco-based journalist.



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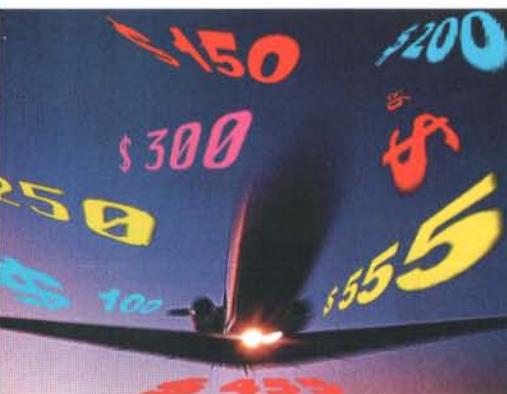
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Name-Your-Price Airline Tickets

For business travelers crammed into crowded rush-hour cabins, it may come as a surprise that the eight major US carriers fly jets at an average of only 65 to 70 percent capacity. When marketer Jay Walker realized this, he began devising a system using the Internet to offer consumers a potential deal on the

millions of seats that fly empty.

The result, Priceline.Com, debuts this month, and, according to Walker, will enable consumers to name the price they'd be willing to pay for airline tickets. At the company's Web site (www.priceline.com/), you simply provide your itinerary, the price you're willing to pay, and your credit card number. If an airline accepts, Priceline.Com



will get back to you within an hour with a nonrefundable ticket.

"This is not for the businessperson," says Walker, whose Stamford, Connecticut-based Walker Digital Corporation lined up 12 investors, built a US\$25 million budget, installed 80 Web servers, and reached "solid" agreements with all the major carriers prior to launch. "We're going to reach what we call the VFR crowd - the visiting-friends-and-relatives crowd. They're the kind of people willing to say, 'For the savings, I'll take a connection in Minneapolis.'

By the end of 1998, Walker expects Priceline.Com to ring up a million hits a day for the 1,000 to 3,000 tickets available daily. To get those hits, he's spending \$10 million to advertise this spring. Says Walker, "The airlines like this system because it gives them an opportunity to add incremental revenue without disrupting their retail-fare system."

- Frank Jossi



Mass Murder Bad for Business

As if moral incentives weren't enough to discourage state-sponsored murder, University of Texas professor Gerald W. Scully proves in his paper "Murder by the State" that killing one's citizens is bad for the economy. For one thing, it's hell on the tax base. There is, writes Scully, "an inverse relationship between the amount of killing of the domestic population and the 'value' of the people being killed." For the complete text of his study, see www.public-policy.org/~ncpa/studies/s211/s211.html. - Brad Wieners

The Wired Interactive Technology Fund (TWIT\$)

Company	Primary Business	Symbol	Shares	Close 1/2	△Since Purchase	Action
ArQuile	Pharmaceuticals	ARQL	8,000	23	+ 5%	hold
Arbor Software	Software	ARSW	4,000	41 1/4	- 1%	hold
Ascend Communications	Network hw/sw	ASND	4,000	25 1/2	- 58%	hold
Aware	Network hw/sw	AWRE	14,000	10 1/2	+ 0%	hold
BioChem Pharma	Pharmaceuticals	BCHE	8,000	21 1/4	- 1%	buy 3,000
Cisco Systems	Network hw/sw	CSCO	3,000	58 1/16	- 4%	hold
Dataware	Software	DWTI	30,000	3 3/16	- 41%	hold
Forte Software	Software	FRTE	15,000	7 1/2	- 68%	hold
Fusion Medical	Medical equipment	FSON	45,000	3 1/2	- 32%	buy 10,000
Informix	Database sw	IFMX	6,675	5 5/16	- 86%	hold
Intel	Microchips	INTC	2,000	72 5/16	+ 4%	hold
PathoGenesis	Pharmaceuticals	PGNS	4,000	37 19/16	+ 5%	hold
Pharmacyclics	Pharmaceuticals	PCYC	7,000	24 1/4	+ 27%	hold
Quick Response Services	Information services	QRSI	4,000	35 1/2	+ 5%	hold
New Holdings						
Pegasus Systems	Online Commerce	PEGS	8,000	15		buy
Oracle	Database sw	ORCL	5,000	22 19/16		buy
Cash Holding	\$110,821					
Portfolio Value	\$2,305,118					
Portfolio Performance since 12/1	-1%			Russell 2000 Index	+ 1%	

Legend: This fund started with US\$1 million on December 1, 1994. We are trading on a monthly basis, so profits and losses will be reflected monthly, with profits reinvested in the fund or in new stocks.

TWIT\$ is a model established by *Wired*, not an officially traded portfolio. Jeffery Wardell is a senior vice president executive financial services representative for Hambrecht & Quist LLC and may have a personal interest in stocks listed in TWIT\$. The opinions expressed herein are those of the author and not necessarily those of H&Q's research department. H&Q has not verified the information contained in this article and does not make any representations to its accuracy and completeness. *Wired* readers who use this information for investment decisions do so at their own risk.

TWIT\$ and the Russell 2000 spent December treading water. Each finished roughly even for the month.

To start 1998, I dipped into the TWIT\$ cash reserves to buy two medical stocks that are off their highs. I purchased 3,000 shares of BioChem Pharma in front of its Hepatitis B drug launch and 10,000 shares of Fusion, which announced on December 17 the completion of a Phase I trial for its proprietary blood-clotting technology, FloSeal Matrix. This trial, conducted at the University of British Columbia's Vancouver Hospital, used FloSeal Matrix to prevent patient blood loss during major surgeries.

Everyone hates the database-software sector right now, but I like this entry point for Oracle. Oracle's stock price has been almost halved since reaching its 52-week high of 42 1/2 on August 20, 1997. Buying now is a pure play on Larry Ellison's ability to restore his greatly diminished net worth.

The only other addition is Pegasus Systems, an online reservation system for the hotel industry. Most of the hotel chains own a piece of the company, and its recent deal with Microsoft positions Pegasus to consolidate a fragmented industry.

- Jeffery Wardell (jwardell@hamquist.com)



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Pushover?



Beijing Banned

When Scott Savitt, founder of the English-language weekly *Beijing Scene*, talked to *Wired* last April ("Agent of Cultural Evolution," page 65), his paper's future was uncertain. In May it folded. The way Savitt tells it, the 25,000-circulation paper was swept up in a phenomenon particular to modern China: As the Hong Kong handover approached, the Beijing government began to look for possible sources of dissent. That same government also happened to publish a monthly competitor, *Beijing This Month*, which was struggling for ad revenue. Both bode poorly for Savitt's enterprise. "These guys from *Beijing This Month* came to me and said 'Don't produce this thing anymore,'" says Savitt. "Their actions clearly weren't legal, but what we were doing wasn't legal, either." In the fall Savitt moved to New York, where he served alongside Chinese dissident Wei Jingsheng as a visiting scholar at Columbia University's School of International and Public Affairs. "We're still trying to negotiate a license," he says. "The newspaper hasn't been coming out for six months, but we still consider the hiatus to be temporary." —Richard Overton



story declared "Webcasting" the new model for Internet content delivery.

But push has fallen far short of the scenarios spun a year ago. What passes as "personalization" today amounts to little more than simple keyword matching or filtering out content categories. And until cable or xDSL modems give home users video capability, small text-based items like stock prices and news headlines are the only content capable of being pushed to large audiences.

Even the word *push* is falling from favor in product descriptions and press releases. Marketers now speak only of Web site "subscriptions," invoking images of the humble daily newspaper instead of a full range of personalized content. PointCast — the original push-media success story — was recently audited as having more than 1 million monthly viewers. Yet even PointCast's Jim Wickett, senior VP of worldwide business development, insists that "PointCast isn't push. It's a news and information service."

The most surprising roadblock for push, though, comes not from technology, but from the intended audience. Push media's promises are often met with outright resentment from computer owners glad to be free of TV's broadcast model. "Many people immediately recognized the democratic potential of the Web," says Julie Petersen, editor at Ikonic, a Web site builder for such companies as Microsoft and Virgin Records. "Consumers are smarter than media organizations thought. When push came along, they said, 'I've seen this one-way communication before. I'm not going to accept it on the Web.'"

Ironically, one successful push technology to date is already in its third decade: email. Internet users loathe spam, but eagerly sign up for regular mailings they deem useful. Netscape's In-Box Direct emails HTML from more than 125 publishers to an estimated 3 million subscribers. Why has email succeeded where pop-up video has stalled? Because consumers have grown acclimated to it over time, rather than having it thrust upon them as a new paradigm by publishers desperate for larger audiences. "People are already programmed to check their email once a day," explains Netscape spokesperson David Bottoms. "We've built on that by enriching email with HTML and links to the Web."

Still, few publishers are willing to admit giving up on the push medium. Instead, push's advent looks to be more evolution than revolution. "Push is an investment," says Dave Fester, Microsoft's group project manager. "It's not magic fairy dust you sprinkle on a product to make it sell better." —Paul Boutin

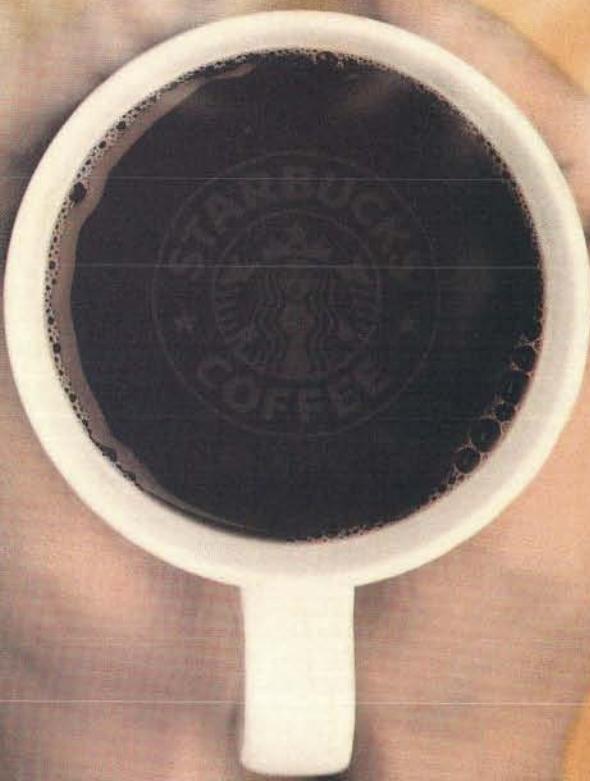
Last March, we told you to "kiss your browser goodbye" ("Push!" *Wired* 5.03). Perhaps we should rephrase that. In early 1997, publishers had high hopes for the new push systems, which could automatically feed personalized content to readers rather than waiting for them to pull it from the Web. Inspired by PointCast's success, dozens of new companies started developing push products. Netscape and Microsoft announced push capability in their forthcoming browsers. *Business Week's* February 24, 1997, cover

Baht Blues

In *Wired's* September 1996 issue, Thai media mogul Sondhi Limthongkul vowed to beam digital satellite television to all of Asia ("Thai in the Sky," page 74). It was part of his grand plan to build a Pan-Asian media empire that includes his regional newspaper *Asia Times* and magazine *Asia Inc.* But the collapse of the Thai baht last spring brought Limthongkul's highly leveraged empire crashing to Earth. Advertising dollars at his publishing businesses plummeted. Awash in red ink, *Asia Times* closed its doors last June after blowing through US\$60 million in 18 months. In August, Limthongkul's private holding company, the M Group, announced it was divesting from not only the satellite project but also two wireless communications ventures that once had been profit workhorses. As of December, *Asia Inc.* was teetering on the brink of bankruptcy. Limthongkul has salvaged an online business, a consulting company, and a handful of other smaller projects — a far cry from his dreams of becoming Lord of the Skies. —Alex Salkever



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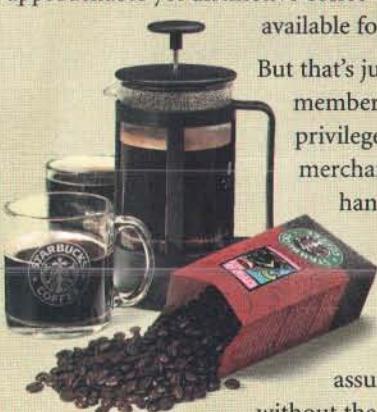
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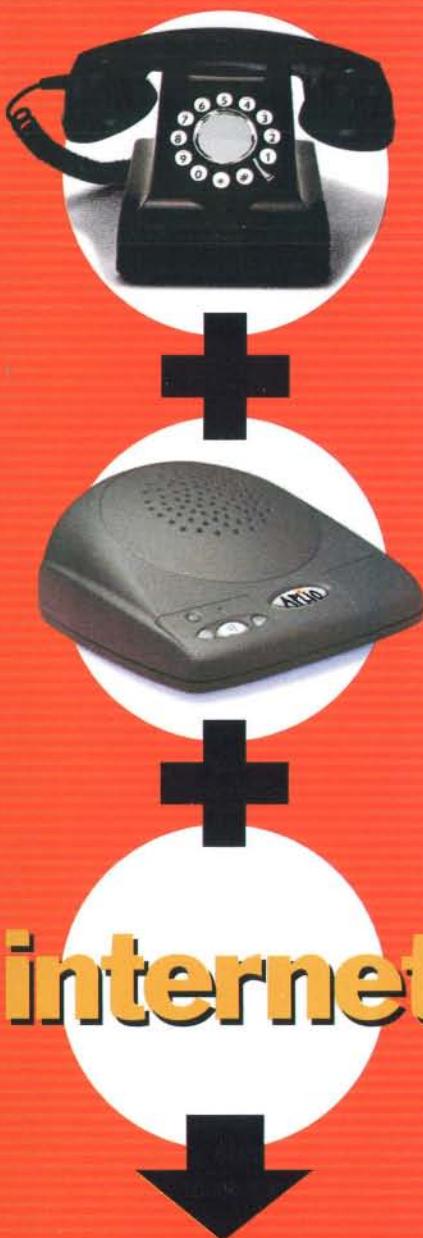
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Ant Wisdom for the Web

Professor **Paul Kantor**'s digital-information pheromones sniff out the good stuff on the Web. But keep your antennae up for intellectual fads and poisoned bait.

When people need a metaphor to describe Web navigation, they usually reach for a spider. Paul Kantor is partial to ants. "They've evolved these chemical systems for communicating information," says the Rutgers University professor of information sciences. "When you look at people dealing with any kind of information system, you realize that each person's decisions - those he or she makes in the course of getting to the right information - are essentially lost to the rest of the world."

Enter digital-information pheromones, or DIPs, the concept at the core of a new Rutgers University project that aims to "antify" the Web by allowing people to leave pointers for those who might follow in their footsteps. But dealing with DIPs is no picnic. Kantor's answer is a network of Ant World Servers and AntApplets that will allow searchers to vote on how well a particular page they land on has satisfied their query.

So what would an ant-enabled site look like? "Our current thinking is that you'd see a tiny ant icon next to a link," explains Kantor. Clicking on the insect would pop up a dialog box describing how useful the Web page behind the link had been to previous visitors.

This bug is a feature:
Rutgers University's Paul
Kantor believes we can
become better Web surfers
by mimicking ants.

The idea dates back to 1987, when Kantor, then a distinguished visiting scholar at the Online Computer Library Center in Dublin, Ohio, sought a way for patrons to leave pointers from one book to another. As the Web grew, so did Kantor's project, until Darpa - realizing how critical information management is to national security - threw US\$1 million into the undertaking. Kantor and colleagues Benjamin Melamed and Endre Boros expect their ants to break out of the lab and tunnel onto the Web by 2000.

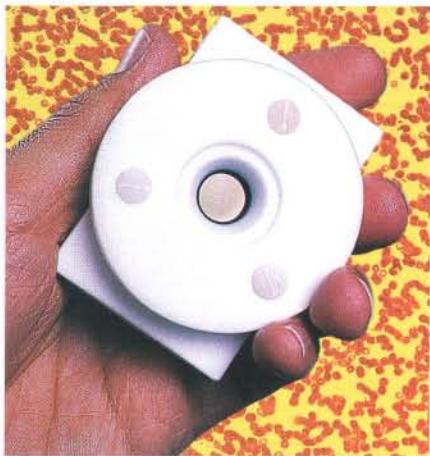
A couple of nagging problems persist. Aside from the inevitable pheromone abuse by unscrupulous marketers, there exists the troublesome issue of trendmongering.

"Intellectual fads are dangerous and wasteful of time," Kantor explains. "If you accumulate a well-worn path to a particular page, how do you get people to another page that has surpassed it in value?"

Furthermore, Web searchers themselves are a flighty bunch. Asking them to rate their findings may be tough when online altruism - and attention - is in increasingly short supply. Admits Kantor, "A lot of our success will depend on not being seen as another flashy ad." - *James Glave*



Super Taster



A hundred times more sensitive than current devices, this biosensor detects compounds such as drugs or bacteria at concentrations as low as 9 quadrillionths of a gram per square millimeter. Created at The Scripps Research Institute and the University of California at San Diego, the sensor uses a chip of porous silicon – with an effective surface area of several square feet – to "taste" the biosample.

—Mark Frauenfelder

Sound Technology

This soda-bottle-sized device would make a swell hood ornament on Buck Rogers's rocket ship – but it's what is going on *inside* the unit that's really the stuff of science fiction. Resonating under the shiny shell are sound waves of an astonishing amplitude – more than 1,600 times higher than any made by humans. Put another way, Los Alamos National Laboratory's Gregory Swift says, "If you were able to somehow find yourself inside the small resonating cavity of this device, hearing loss would be the least of your worries. Your hair would catch fire."

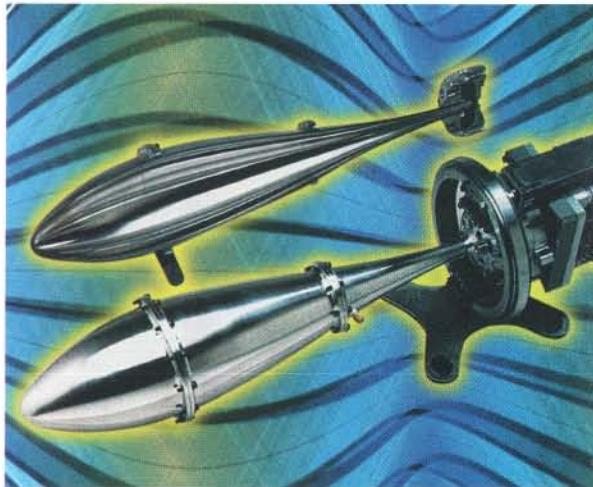
The technology is called resonant macrosonic synthesis (RMS), a revolutionary method of generating and harnessing superhigh-energy sound waves that's finding its first uses in home refrigerators and air conditioners.

Unveiled last December in San Diego at the 134th meeting of the Acoustical Society of America, RMS is the innovation of Tim Lucas, founder and CEO of MacroSonix in Richmond, Virginia.

By experimenting with gas-filled chambers of different cone and bulb shapes, Lucas and his colleagues found it possible to eliminate the pesky shock waves that typically limit the

energy levels of sound waves, yielding unprecedented pressure levels.

Beyond home refrigeration, RMS may find uses in process reactors, noncontaminating



compressors, and pumps for commercial gases and ultrapure or hazardous fluids (technologies crucial to the semiconductor and pharmaceutical industries). On another front, RMS could be combined with pulse combustion to convert fuel to electric power. —Jim Leftwich

The Great Push Forward

The Chinese State Economic and Trade Commission has unleashed its recipe for jump-starting 166 state-of-the-art technologies during China's ninth Five-Year Plan (1996-2000). The document, which targets China's industrial sectors – including electronics, transportation, power generation, and telecommunications – is yet another quinquennial projection spewed forth by the Chinese government, a practice dating back to the early days of the People's Republic in 1953. But don't

mistake the blueprint for just another bureaucratic wish list: it's China's high tech R&D hot sheet.

The government hopes that the six Chinese firms slated to receive priority investments of 20 million yuan (US\$2.4 million) each will rank among the world's 500 largest companies by 2010.

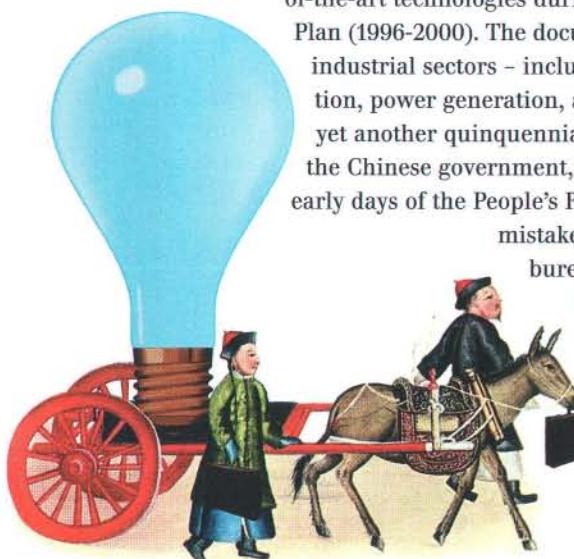
The funding is awarded under

one condition: the firms must promise to undergo technological development while steadfastly adhering to state regulations.

Though kowtowing to government policy may seem an anachronistic gesture in China's increasingly market-driven economy, the state still calls the shots, according to Wei-chou Su, managing director of the US Information Technology Office in Beijing: "The state regularly designates key R&D projects where it provides the people, the money, and the facilities to boost development. This has been the tradition here, and it works quite well in the Chinese context."

Literature released by the Chinese State Economic and Trade Commission also touts the efficacy of R&D "in the Chinese context," claiming that 1,384 new products were developed last year and that sales volume on these products is expected to reach 180 billion yuan (\$21 billion). Deng Xiaoping would be pleased: China's cat is not only still catching the mouse, it's being spoon-fed multivitamins to do the task even better than before.

—Kristie Lu Stout



Telecom Goes Qwest

An upstart firm uses the Internet and state-of-the-art fiber laid alongside railroad tracks to offer phone service at half the going rate. By Steve G. Steinberg

Qwest Communications's December announcement of 7.5-cents-per-minute long distance phone service was the opening shot across the bow of the telecom behemoths. It wasn't so much that the Denver telco had undercut the competition by 50 percent, it was that it was using voice-over-IP (VOIP) technology to do so.

Protesting that the technology just isn't ready yet, AT&T, Sprint, and even WorldCom have taken a cautionary position on the idea of unifying data and voice over a single network. Qwest, on the other hand, went out and did it. While the big guys were captive to their aging networks built for voice, Qwest took advantage of the fact that its network was designed for data.

"What's going on is a revolution in telecom," says Joseph Nacchio, Qwest's CEO and a former AT&T exec. "It's going to be as dramatic as the shift from the telegraph to the telephone," echoes Nayal Shafei, Qwest VP and a graduate of the MIT Media Lab. "We aren't a telco, we're a multimedia carrier."

Tired rhetoric, perhaps. But the fact that a 6-year-old start-up

led by an unlikely team of old telephony hands, computer scientists, and construction experts now has a market cap of US\$6 billion and its competition on the run is reason enough to listen. And once you learn what lies behind the 7.5-cent solution, it's hard not to believe that Qwest is right.

The Qwest story begins with Philip Anschutz. A billionaire who made his money from oil and railroads, Anschutz bought Southern Pacific Railroad for \$1.8 billion in 1988 and sold it eight years later to Union Pacific for \$5.4 billion. But the real coup was that he kept the rights-of-way that run parallel to Southern Pacific's tracks. These narrow strips of real estate became the basis for Qwest's network, providing a home for 13,000 miles of fiber-optic cable strung underground across the US.

Buried alongside the train tracks are now two conduits. The first contains state-of-the-art cable, called nonzero dispersion-shifted fiber, that can carry far more data than the older fibers laid by companies like Sprint and AT&T during the 1980s. The second conduit lies empty, giving Qwest an open track to lay next-generation technology quickly. Combine Qwest's fiber

with the latest in data transmission and you have a network far ahead of the competition. "Our network can't be duplicated by the other carriers," says Nacchio. "It would be like trying to refurbish a 10-year-old PC with a new processor and hard drive rather than buying a brand-new one. It just doesn't make economic sense."

The fast-talking, straight-out-of-New Jersey Nacchio should know. He was the head of AT&T's consumer business. Nacchio maintains that the telephone companies aren't stupid, they're just hamstrung by their shareholders.

"The telcos realize that a revolution is occurring, but what are they going to do?" he asks. "If they say they are going to cut their margins by 50 percent to compete in this new competitive environment, their stock will drop 30 points."

Qwest isn't tied to those old margin structures. The firm's Internet-savvy technology and massive network capacity allow it to achieve with 7.5-cent rates the same margins the other carriers get on tolls twice as high. For the most part, these savings come from lower equipment costs. Instead of using switches from Lucent or Nortel that cost tens of millions of dollars, Qwest uses Cisco routers priced at maybe a million.

The savings also come from the inherent advantages of packet switching over circuit switching. Instead of tying up an entire phone line's capacity no matter how much is actually being sent, IP sends packets only when there are packets to send. Most amazing of all, none of this savings requires a trade-off in voice quality.

This is all part of the plan. Right now, no one is using VOIP, so bandwidth isn't a problem. Still, while Qwest will likely be able to meet the technical challenges, the company is untested when it comes to functions like customer support.

So what's next for Qwest? Shafei says that the company will offer data services like virtual private networks and concurrent engineering, where engineers collaborate over the network using high-bandwidth CAD images.

Maybe calling Qwest a multimedia carrier isn't as hackneyed as it sounds. ■ ■ ■



Multimedia carrier:
Qwest CEO Joseph Nacchio uses packets to outpace – and underprice – the competition's circuits.

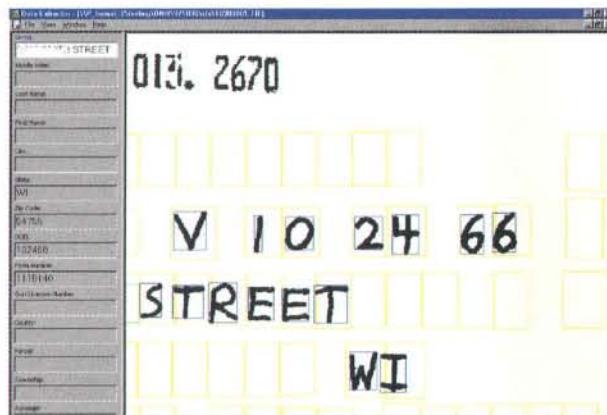
Character Recognition Sheds Its Neurons

Humans have a hard enough time detecting their own handwriting – imagine trying to make software smart enough to comprehend the penmanship of every sloppy writer on the planet, and you see the challenge optical character-recognition software developers have had for the past 30 years.

But the suburban-Minneapolis company Silicon Biology believes that it has a far more accurate OCR program than its competitors, which rely on technology the firm considers fundamentally flawed. Dubbed Fermat, Silicon Biology's program uses a preclassification system based on a genetic algorithm akin to natural selection. In contrast, other OCR programs use a neural network based on the theories of the late Russian mathematician Andrey Kolmogorov. The neural model studies the shape and slope of handwriting in determining content, while Fermat assesses the approximately 20,000 ways a human could write a letter of the alphabet or a number.

But does Fermat really have other OCR programs beat? Yes, says Tony McKinley, a consultant with Pennsylvania-based Intelligent Imaging, who tested Fermat against 50 competitors. "It's not 100 percent accurate, but it outperformed other OCR systems by a factor of 50 percent or better."

After a six-year struggle to get the firm off the ground, Silicon Biology founder Eric Anderholm and his staff of 30 have begun to carve out a slice of the US\$15 billion form-processing industry, attracting a handful of clients, HMOs and insurance companies among them. But data forms may



not be the only area the company applies its expertise. CEO Doug Johnson says that the technology can also be applied to classifying spoken words, Asian-language characters, and white blood cells (a process now performed by the naked eye and a microscope). – *Frank Jossi*

Mugspotter

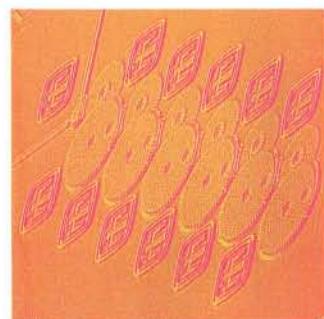
Criminals beware: Person Spotter may be watching. This new face-recognition software, based on biological vision, can spot a moving mug and know in seconds whether it's on the most-wanted short list. Even a mustache or sunglasses can't fool the system.

"Our goal is much more ambitious than face recognition," says Person Spotter's codeveloper, University of Southern California professor Hartmut Neven, who with his colleagues at USC and Germany's Ruhr University-Bochum founded the company Eyematic Interfaces to bring their system to market.

Indeed, the program is advanced enough to recognize individuals walking into a room and will soon be able to determine whether the visitors are grinning or scowling. The process works by first identifying a person's location in an image, then analyzing color and motion cues, and finally extracting the outlines of features at a fine scale, which it compares with patterns in the database.

Person Spotter's first commercial task is to control access to sensitive internal areas in offices at Germany's Deutsche Bank. Neven also visualizes airports using the system to combat terrorism by tracking passengers and their luggage. – *David Pescovitz*

Tiny Transmission



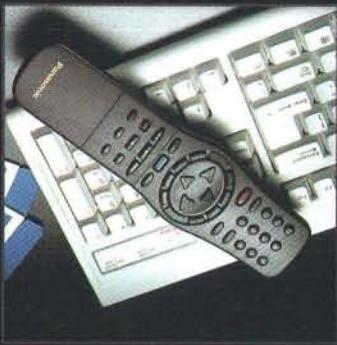
The problem with motors the size of a grain of sand is their commensurately puny power output. The solution? A micro gearbox – the one shown here was developed at Sandia National Laboratories – that increases the torque (and proportionally reduces the rpms) of a micromotor. This technology opens up a wide range of applications, from satellites to surgical instruments.

– *Mark Frauenfelder*

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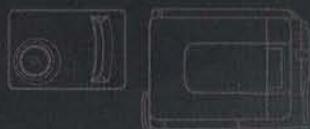
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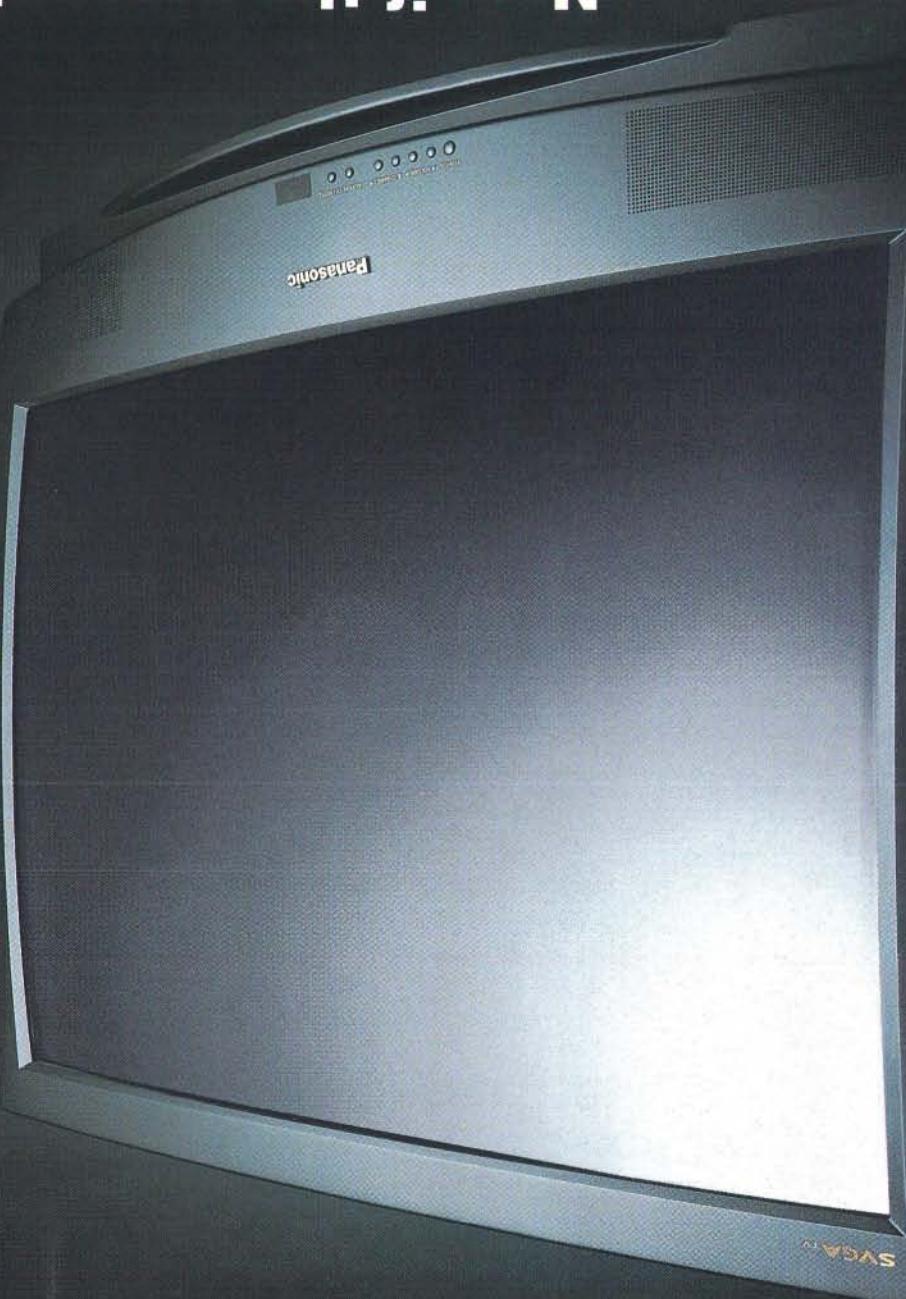
Panasonic introduces a 36" diag. SVGA monitor that's also a high-performance TV.

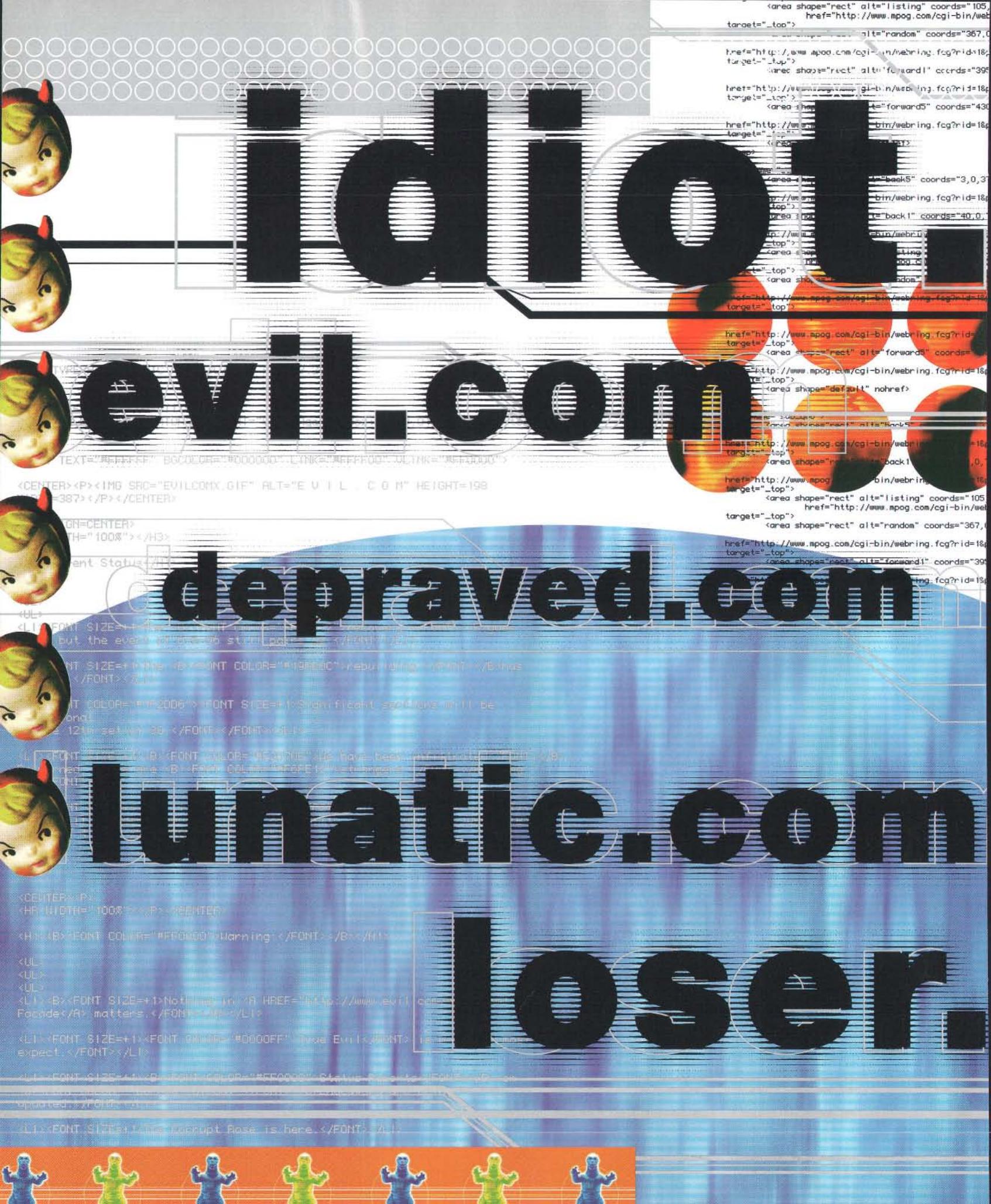
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Deflating this month's overblown memes.

By Steve G. Steinberg

Home Networks

1 12

On the Rise/
In Decline

Ranking

Life Expectancy
(Months)

The hot new way to attract venture capital is to develop LANs for the home. Currently Tut Systems and Epigram lead the pack with proprietary schemes to run Ethernet over existing telephone wire, and competitors are chomping at their heels. Analysts say the 11 million US homes with

multiple PCs are proof of a burgeoning market, but home LANs are really driven by the desire of electronics manufacturers to get televisions and DVD players onto the Net. While the technology may be sound, does my TV really have anything to say to my PC?

XML

2 6

XML, say breathless advocates of Extensible Markup Language, will let us organize the Web. Any sentence involving the Web and organization should give you pause: the two concepts are incompatible. XML shows why. This standard allows subject-specific tags so that, for example,

music reviews can be labeled <music-review>. To find a review, search the Web for the tag. The problem, of course, is that everyone must agree to use the same tags, which is like saying all netizens must speak Esperanto – and about as likely to happen.

Cable Modems

3 3

Observing the race between telcos and cable companies to deliver high-bandwidth connections to the home is like watching a horse race between two lazy nags. Who wins is less surprising than that they even move. The most recent stumble of progress was made by the cable companies, who

managed to arrive at a cable modem standard. That feat, according to the press, has catapulted cable operators into the lead. Don't believe it. The existence of a standard modem card doesn't make me any more inclined to let the cable guy open up my PC.

Juniper

4 6

Maybe it's because everyone loves an underdog. Or maybe it's just what happens when a firm is led by a former sales and marketing executive. In any case, Juniper Networks, an Internet router start-up, has taken the vaporware prize of the year: It has been showered with US\$55 million

from investors like Nortel and UUNet, it's the toast of the industry press, and marketingwise it has Cisco on the run. Yet Juniper hasn't publicly shown a half-working box. Of course, if the company's smart, it will keep it that way. By now, Juniper can only disappoint.

Trepanation

5 3

Like most trends, this seems to have started as a joke. Trepanation – aka drilling a hole in your head – was the province of conspiracy-theory satirists, who melded talk of the Illuminati's third eye with the virtues of brain aeration. But as Umberto Eco so astutely comments, fringe fic-

tion has a way of reinforcing fact. In the case of trepanation, accounts are growing of actual people drilling actual holes in their skulls. Subjects report a feeling of well-being, if not higher consciousness. Perhaps this comes from the sheer relief of surviving acts of idiocy.

hype-list@wired.com

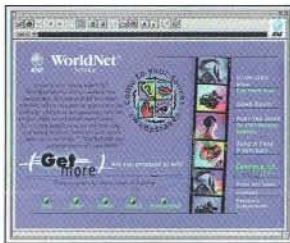
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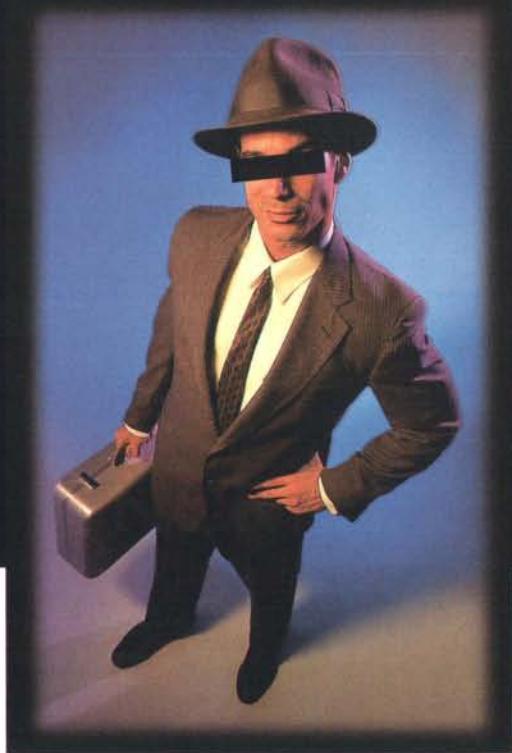


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The Special Master

The court has ruled that **Lawrence Lessig** holds no anti-Microsoft bias. But that doesn't mean that Bill Gates should rest easy.

Last December, when Judge Thomas Penfield Jackson appointed Lawrence Lessig to serve as a "special master" in the antitrust case of *US v. Microsoft*, the news immediately plunged the quiet, 36-year-old Harvard University law professor into the spotlight. The *San Jose Mercury News* called him "techno-savvy." *The New York Times* deemed him "one of the leading intellectuals of his generation in American law." Microsoft's lawyers were less generous, arguing that Lessig should be removed from the case for having shown "clear bias" against the company.

Judge Jackson flatly rejected Microsoft's bias claim, giving Lessig until May 31 to investigate Microsoft's business practices and report "findings of fact and conclusions of law" that the court will consider in making a final ruling in the antitrust case. As special master, Lessig has been invested with much of the authority of a federal judge - including the power to issue subpoenas, gather testimony, and find parties in contempt.

Lessig's report is likely to have a significant impact on the destiny of Bill Gates's US\$150 billion software empire. The philosophical differences between the two men are noteworthy - while Gates is famous for his single-minded determination to consolidate Microsoft's market dominance, Lessig is best known for his efforts to

protect individual liberty by preserving the Internet's open architecture.

In his academic work, Lessig has considered three types of regulation that govern life in cyberspace. The first is law, "the most obvious regulatory constraint." The second is social norms - the informal rules of netiquette that guide the Internet's complex sociology. Lessig believes these forms of regulation are optional because they function as directives that one can choose not to obey. But the same cannot be said for the third type of regulation - technological constraints inscribed into the Internet's software architecture. As he wrote in this magazine last year, "Software code - more than law - defines the true parameters of freedom in cyberspace." (See "Tyranny in the Infrastructure," *Wired* 5.07, page 96.)

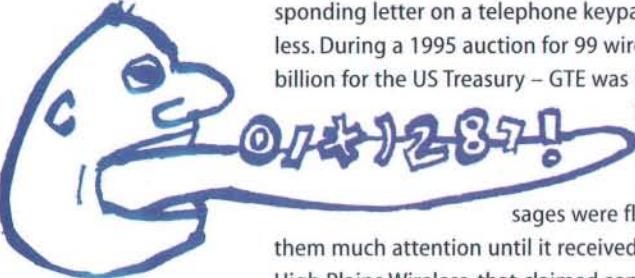
During the months ahead, Lessig may bring these theories to bear in the Microsoft case. As a law professor, he proposed that "the question of what the architecture of cyberspace should be is not a neutral question. We need to think about it in political terms." Now, as special master, he has been asked to resolve a thorny political controversy: Which system of regulation best serves the interests of cyberspace - Uncle Sam's antitrust laws, or Bill Gates's operating-system code?

- Todd Lappin

Man in the middle: Lessig is poised to play a pivotal role in the antitrust case of *US v. Microsoft*.

Fixing the Numbers

The Federal Communications Commission is taking steps to stamp out fun and games – and perhaps illegal collusion – during spectrum auctions. In the past, bidders occasionally signaled one another by submitting bids for extremely specific amounts that could be decoded by matching each number with a corresponding letter on a telephone keypad. In most cases the messages were harmless. During a 1995 auction for 99 wireless phone licenses – which raised US\$7.7 billion for the US Treasury – GTE was in a particularly tough battle with Sprint.

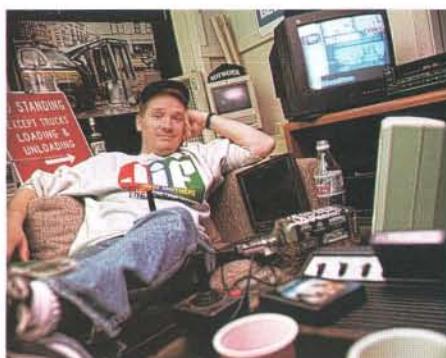


During one round GTE bid \$47,248,363 – the last six digits of which spell "Bite Me."

The FCC has long known that these messages were flying around, but the agency never gave them much attention until it received a complaint last year from a losing bidder, High Plains Wireless, that claimed some bids contained secret messages that amounted to illegal collusion. The complaint prompted a formal investigation by the FCC, which, in turn, prompted the Justice Department to open its own investigation. Both inquiries are ongoing.

If the Feds adopt a strict interpretation of the law – which seems unlikely – any coded message could be deemed illegal, forcing the government to reauction dozens of licenses and delaying the delivery of wireless services to the public. But while the investigation continues, the FCC hopes to head off any future problems by simply changing the rules of the game – players in all future spectrum auctions must submit bids in nice round numbers. – *Mark Lewyn*

The Hacker Safe House



On the sixth floor of an office building in midtown Manhattan, the studio space of Notwork Development Labs serves as an after-hours playpen for 11 hackers who have banded together to split the cost of rent, utilities, and a T1 Internet connection. Notwork also serves as a sort of safe house – hackers from Amsterdam and London have bedded down in the studio, which has also been host to underground luminaries Phiber Optik and Bernie S. "It's not a hostel," says Notwork member Ryan Nelson. "But we've got lots of friends from other places who prefer a crash pad with a T1 to a US\$140 hotel." – *Ben Greenman*

Privacy Imperfect

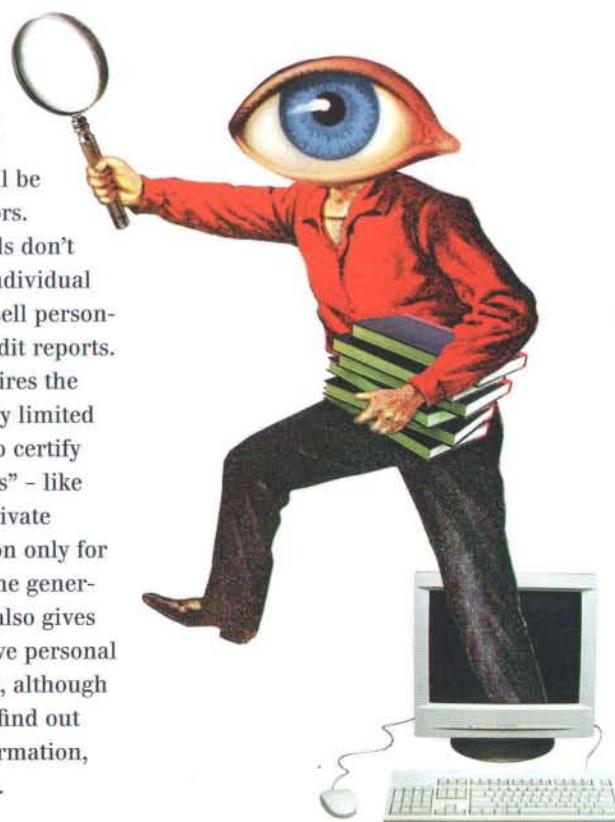
In the summer of 1996 Internet users raised a ruckus after learning that the P-Trak service run by Lexis-Nexis was selling individuals' Social Security numbers, addresses, and unlisted phone numbers. The outcry prompted members of Congress to consider legislation that would prevent credit bureaus from selling such information to lookup services such as P-Trak. Instead, Federal Trade Commission chair Robert Pitofsky persuaded a few key senators to accept his mantra that "voluntary regulation by industries works best."

In December Pitofsky unveiled an agreement among the government, lookup services, and credit bureaus. Among the 14 parties to the agreement, three major credit bureaus and two "information brokers" have been previously cited by the FTC for violating consumer regulations, while three of the lookup service operators have been caught violating the ethical guidelines of

the Direct Marketing Association. The new plan establishes a set of self-regulation principles that will be monitored by independent auditors.

Critics charge that the proposals don't go nearly far enough to protect individual privacy. Credit bureaus can still sell personal information obtained from credit reports. On the other hand, the plan requires the services to provide marketers only limited access to sensitive information, to certify that certain "qualified subscribers" – like law enforcement agencies and private investigators – use the information only for "appropriate uses," and to deny the general public access. The agreement also gives consumers the opportunity to have personal data removed from the databases, although in practice it provides no way to find out which services maintain the information, or how to get in touch with them.

– *Robert Ellis Smith*



Mergers and Consolidations

After helping to defeat the CDA, grassroots activists may become victims of their own success. By Rebecca Vesely

According to Jon Lebkowsky, cofounder of EFF-Austin, the Supreme Court's decision to strike down the Communications Decency Act was great for the Internet, but horrible for his seven-year-old activist organization. "After the CDA decision, there wasn't a lot of energy for EFF-Austin," Lebkowsky says. "Grassroots organizations are strongest when there is a demon defined."

The CDA challenge marked the first time that civil liberties activists used the Internet to reach the public, and their success provided an impressive demonstration of the medium's political potential. Online demonstrations, such as the

Francisco-based Electronic Frontier Foundation. "People are happy to hear we are doing this work, but when it comes to getting them to volunteer, it's difficult to get anyone to commit."

The groups that have done the best in the post-CDA climate are those that have honed in on a single, high-profile topic. NetAction, a two-person activist shop in Northern California, now focuses primarily on its campaign to "stop Microsoft from seizing control of cyberspace." Sun Microsystems, one of Microsoft's chief nemeses, gave NetAction an undisclosed sum of money last fall.

But most other grassroots groups do not have corporate sponsors. "We chose not to seek corporate dollars, because we did not feel we could compete with Washington insiders," says Shabbir J. Safdar, founder and advisory board member of the New York-based Voters Telecommunications Watch. In December Safdar stepped down as head of VTW to start an Internet consulting firm in Washington, DC, leaving the future of VTW hanging in the balance. And some activists complain that foundations consistently reject funding proposals from small groups and that most grant money for online activism is directed toward projects that help disseminate Internet technology.

Although money is definitely an issue for the small groups, the nature of online activism keeps costs low. "The Web server is our only expense, and that costs about a dollar a day," says Peacefire's Haselton. EFF-Austin supported itself for years on T-shirt sales and special book-signing parties by cofounder and SF author Bruce Sterling. And, as for all the paperwork needed to get nonprofit status for tax deductions, most haven't gotten around to it.

When another big free-speech fight comes around, grassroots groups say they will be ready. But for now, many are looking for ways to consolidate resources. In January, EFF-Austin decided to change its name to EF-Texas, in hopes of attracting activists from other parts of the Lone Star State. "It's tough," says Lebkowsky. "Getting these guys together is like trying to organize anarchists." ■ ■ ■

Rebecca Vesely (rebv@ix.netcom.com) wrote "The Generation Gap" in *Wired* 5.10.

As large, professional groups move to the forefront, smaller online organizations are struggling to cope with rampant user apathy and a new range of cyber rights issues.

that can afford to file expensive legal cases," says Bennett Haselton, founder of Peacefire, an online activist group for minors.

Last year Haselton, a Vanderbilt University student, revealed that Cybersitter, a popular Internet filtering program, blocked access to such sites as *Mother Jones* magazine, the National Organization for Women, and organizations for gay and lesbian youths. "Bennett is a good example of the effectiveness of grassroots organizing," says Jonah Seiger, an Internet consultant and former communications director for the well-heeled Center for Democracy and Technology in Washington, DC. "We wouldn't be having a debate over blocking software if it wasn't for Bennett."

The White House's new hands-off approach to the Net has only made things worse for small groups by intensifying the struggle to garner support. "Apathy is rampant," says Scott Brower, executive director of EFF-Florida, which, like EFF-Austin, is not affiliated with the better-known San



"A few years back, we had Internet issues all to ourselves," says Jon Lebkowsky of EF-Texas. "But today the environment for online activism has become saturated."

Mr. O'Connell Goes to Concord

To understand who really has clout in the political world, follow the money. Marcus O'Connell, a financial analyst in Concord, California, heard rumors that property developers were giving large sums of cash to members of the city council, but when he visited city hall to check the contribution records, he found a handful of documents stuffed in a binder. "We needed a database," O'Connell says. "It's the only way to make sense of all the different entries."

Inspired, O'Connell became the first private citizen in the United States to compile a database of local campaign contributions and post it on the Web (pwp.value.net/marcus/campfin/). Other such resources exist in cyberspace, but they mostly concern state and federal campaigns and are produced by experts at nonprofit organizations. O'Connell's effort was a one-man job,

created with Excel spreadsheet software to shed a little light on politics in his hometown.

O'Connell's number crunching has shown that members of the Concord City Council have long been accepting heavy-duty contributions from local developers, sanitation companies, and lawyers. His most eye-opening revelation was the disclosure that since 1993, Bill Graham Presents, a national concert promoter, has sidestepped contribution caps and funneled more than US\$11,000 to council members through company employees who made some 27 separate donations. Coincidentally, the council recently approved a costly overhaul of the Concord Pavilion, a lavish, city-owned outdoor amphitheater and concert venue.

O'Connell hopes the Net can put voters back in the game by giving them unfiltered access to information. "We have the capability now," O'Connell points out. "It's in our hands." — *David Lazarus*

Pirates Beware



Next time, think twice before you copy that floppy. On December 16, President Clinton signed the No Electronic Theft Act, a measure sponsored by Representative Bob Goodlatte (R-Virginia) that criminalizes the unauthorized "reproduction or distribution" of computer software, books, musical recordings, or videos worth at least US\$1,000. Designed to close a loophole that may have legalized noncommercial duplication of copyrighted material, the new law targets "any person who infringes copyright willfully," with criminal penalties that range from fines to six years in prison.

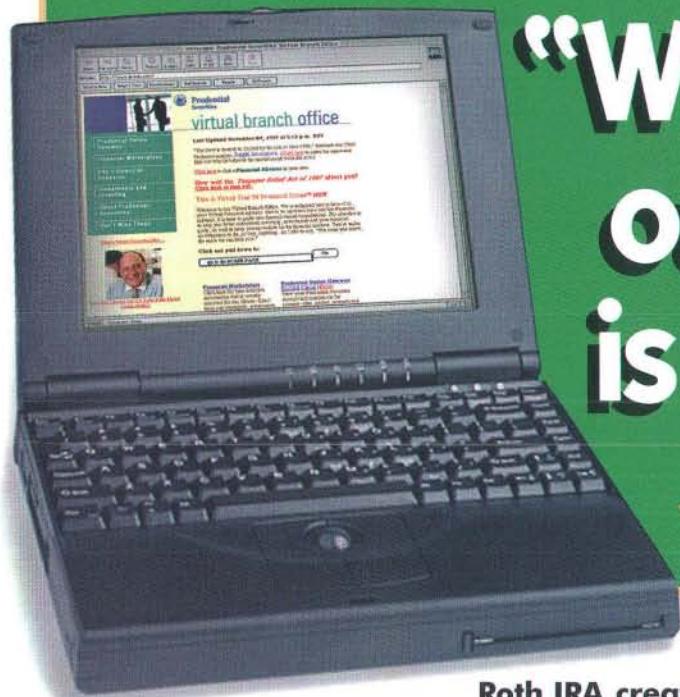
— *Todd Lappin*

Maximum Copyright, Minimum Use



Overprotective digital-copyright rules, much like the ones that were proposed and rejected at a December 1996 diplomatic conference in Geneva, have resurfaced in the European Community's latest plan to implement the World Intellectual Property Organization Copyright Treaty. Under the proposals, nations of the European Union would be required to treat almost all temporary and indirect copies of copyrighted works in digital form as "reproductions" subject to copyright regulation. In addition, the legislation would curtail the authority of EU nations to enact or maintain fair or private-use privileges in their national laws. The measure also contains a byzantine provision that would outlaw many legitimate technologies that have incidental infringement-enabling uses.

This may be good news for US high tech companies, as the EC's overzealous copyright proposals could strangle Europe's nascent high technology industry. On the other hand, if copyright maximalism prevails in Europe, Clinton administration officials may try to resurrect similar legislation that has been stalled in Congress for the last two years. Fortunately, Senator John Ashcroft (R-Missouri) and Representatives Rick Boucher (D-Virginia) and Tom Campbell (R-California) have introduced legislation in Congress that is far more enlightened and balanced — in the form of S 1146 and HR 3048. Meanwhile, the European Council of Ministers, particularly if opponents lobby for changes along the lines of the Ashcroft-Boucher-Campbell bills. — *Pamela Samuelson*



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ENCYCLOPEDIA

OF THE

NEW ECONOMY

By John Browning and Spencer Reiss

So what is the new economy?

When we talk about the new economy, we're talking about a world in which people work with their brains instead of their hands. A world in which communications technology creates global competition – not just for running shoes and laptop computers, but also for bank loans and other services that can't be packed into a crate and shipped. A world in which innovation is more important than mass production. A world in which investment buys new concepts or the means to create them, rather than new machines. A world in which rapid change is a constant. A world at least as different from what came before it as the industrial age was from its agricultural predecessor. A world so different its emergence can only be described as a revolution.

PART I

Free markets are central to it. The Soviet Union's collapse settled the debate between market economies and planned ones. But simply to say that the new economy is about the unprecedented power of global markets to innovate, to create new wealth, and to distribute it more fairly is to miss the most interesting part of the story. Markets themselves are changing profoundly. To understand that, start by examining the mystery of Microsoft.

The fact that Bill Gates is the world's richest man belies a huge shift in the values of capitalism. Microsoft has annual sales of US\$11 billion, and most of its assets walk in and out of the doors wearing T-shirts. Yet the stock market values the company at well over \$150 billion – far more than either IBM (sales \$76 billion, market cap \$100 billion) or General Motors (sales \$160 billion, market cap \$50 billion). Why? Because the rules of competition are changing to favor companies like Microsoft over paragons of the industrial age.

Microsoft's rise is a testimony to the power of ideas in the new economy. Working with information is very different from working with the steel and glass from which our grandparents built their wealth.

Information is easier to produce and harder to control than stuff you can drop on your foot. For a start, computers can copy it and ship it anywhere, almost instantly and almost for free. Production and distribution, the basis of industrial power, can increasingly be taken for granted. Innovation and marketing are all.

So an information economy is more open – it doesn't take a production line to compete, just a good idea. But it's also more competitive. Information is easy not just to duplicate, but to replicate. Successful firms have to keep innovating to keep ahead of copycats nipping at their heels. The average size of companies shrinks. New products and knockoffs alike emerge in months rather than years, and market power is increasingly based on making

sense of an overabundance of ideas rather than rationing scarce material goods. Each added connection to a network's pool of knowledge multiplies the value of the whole – one reason for Microsoft's astonishing growth. The result: new rules of competition, new sorts of organization, new challenges for management.

Some zealots talk about a New Economy, capital *N*, capital *E*, all too easily caricatured as "there won't be inflation anymore, because of technological change." Alas, as Stanford economist Paul Romer has reminded us, "If a majority of the Fed's board of governors decided to have 20 percent inflation, they could have it in a year, possibly in months." Then there's the idea that recessions are things of the past. This comes up at the end of every expansion.

What's true is that the shift to an information economy is redefining how we need to think about both good times and bad. We don't know how to measure this new economy, because the productivity of a decisionmaker is harder to grasp than the productivity of someone bolting together cars. We don't know how to manage its companies, because decisionmakers can't be told what to do. We don't know how to compete in it, because information seeps so easily that supermarkets now offer banking services and Amazon.com has infiltrated its virtual bookshelves into Web sites the world over. We don't know how to oversee it, or whether it ultimately needs oversight at all.

A final thing we don't know is where – or how – the revolution will end. We are building it together, all of us, by the sum of our collective choices. To help inform the architects of this new world, we've assembled an Encyclopedia of the New Economy. Part I starts here. Parts II and III will follow in *Wired*'s next two issues. Read on, pioneer.

– **John Browning**

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Adhocracy *Organization without structure.*

Adhocracies have long been used by creative enterprises – film studios and ad agencies, for instance – to produce a steady flow of differentiated products. They are a mirror image of the well-defined bureaucracies that built most industrial organizations: instead of a strict rule book, there exists an evolving collection of shared goals. Start-up software companies are a classic example. Instead of fixed tasks and job descriptions, everyone does what needs to be done. Computer networks encourage adhocracy by enabling people to continuously share information and coordinate themselves informally.

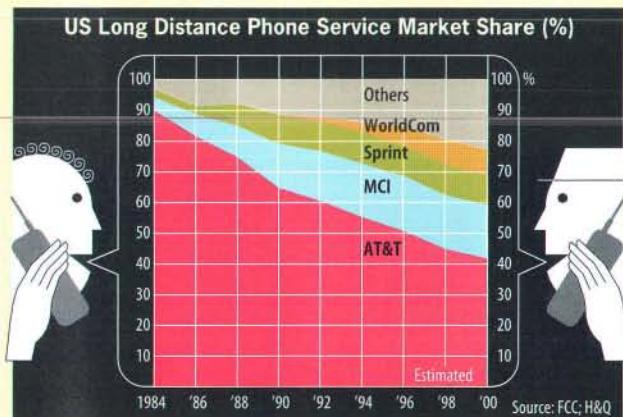
Attention economy *A marketplace based on the idea that while information is essentially infinite, demand for it is limited by the waking hours in a human day.*

Attention economics has been around for at least as long as there have been commercial media, whose true products are not sitcoms (or magazines), but eyeballs for advertisers. Interactive media take this concept a step further: they allow attention – say, a Web site's traffic – to be bought, sold, or bartered and instantly shipped to other sites anywhere in the world. And the whole business can be scaled up to a billion people watching the Olympics or down to a custom-tailored audience of you.

Attention economics helps explain some of the Net's seeming commercial anomalies, including the explosive growth of high-visibility navigation sites like Yahoo! and the proliferation of free (to the user) products and services. Another example is the skyrocketing value of bankable sports, film, and TV stars who can catch eyes amid the fray. In an ever more trafficked world, tools for getting (and keeping) attention will be increasingly valuable.

AT&T, breakup of *The beginning of the end for old-fashioned telecom monopolies and the first step toward truly global data networks.*

In January 1984 an antitrust agreement negotiated by US federal judge Harold Greene forced what was then the world's largest company to spin off the seven Baby Bells and open the US long distance phone market to competition. Starting with MCI and Sprint, the result has been lower prices, better performance, and an explosion of



new companies and services, which continues today with everything from digital cell phones and callback services to low-Earth-orbit satellites and upstart Internet-based networks such as WorldCom and Qwest.

AT&T's breakup reflects a fundamental change in thinking about the nature of telecommunications. Traditional copper-wire-based telcos were seen as "natural" monopolies, endowed with insurmountable economies of scale. But technological advances – from fiber-optic cable and computerized switching to such mundane matters as automated billing – have transformed telecom into a fluid, increasingly global market.

Since 1984 more than 40 state-owned telcos around the world have been privatized and opened to competition. Sheer size still gives entrenched telecom giants formidable clout. But prices for voice and data transmission continue to plummet – a key to the new economy's growth.

Bailout, IMF *Financial life support for developing countries that overdose on free-flowing global capital.*

Since 1990 investors chasing double-digit annual returns have poured more than \$1.2 trillion into emerging-market economies. But unreformed local banking systems have often failed to keep pace, steering the new funds to political cronies and overhyped industrial projects. Eventually, their currencies weaken, speculators attack, and loans collapse. Then the International Monetary Fund is called to provide emergency financing, most recently the \$100 billion-plus in rescue packages extended to South Korea and other Asian "tigers" late last year.

The IMF, a staid central bankers' club headquartered in Washington, DC, worries about the risk to an increasingly global economy of allowing even a second-rank economy like Thailand's or Malaysia's to collapse. But critics say that bailouts are themselves part of the problem, providing a de facto safety net for the big international banks and encouraging more market-distorting bad lending.

Bandwidth *A network's carrying capacity, rarely sufficient.*

The term *bandwidth* used to mean the size of the slice of the radio spectrum available for a transmission. Today it is mostly used to describe the rate at which information – measured in bits of data per second – can move between computers. As such, bandwidth determines a network's ability to deliver information goods and services. But that also makes it one of the new economy's key limiting factors – ask a Web surfer stuck with a 28.8-Kbps modem, or consider MTV pondering (in the near term, anyway) online music videos.

Fiber-optic cable – currently being laid as fast as backhoes can dig trenches – and the late arrival of TV's deep-pocketed cavalry are changing that. Pundit George Gilder has proposed a bandwidth corollary of Moore's Law: Backbone capacity will triple annually for the next quarter century. It could happen. Already, corporate Internet users are measuring their access in gigabits per second – sufficient to start realizing the trillion-dollar pipe dream of TV and Internet convergence. Meanwhile, the \$2 billion,

Denver-based telco Qwest is building from scratch a new US network with a top capacity of 2 terabits (2 trillion bits) per second - sufficient to transmit the entire contents of the Library of Congress cross-country in 20 seconds.

The astonishing economies of fiber-optics have revived - more quietly, this time - a version of the nuclear-power industry's old slogan: bandwidth could someday be "too cheap to meter." But for homes in particular, despite talk of wireless solutions, there remains the "last mile" problem of pulling fiber to individual customers. And then there is a question that the old economy answered by forcing regulated phone monopolies to provide universal service: Should everyone go to bandwidth heaven together?

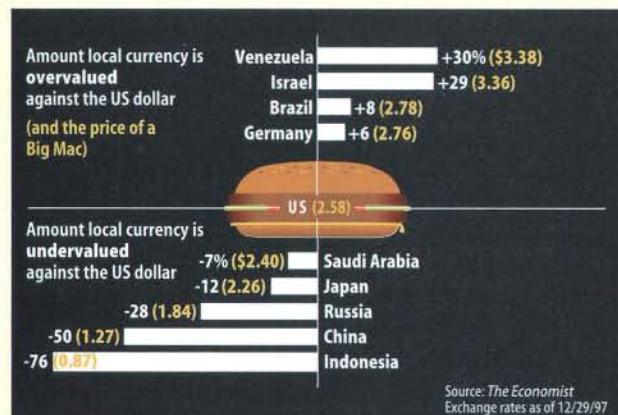
Big Bang *The birth of global financial markets.*

On October 27, 1986, the London Stock Exchange followed its New York counterpart and abolished fixed commissions on share trading, setting up a free-for-all. What came to be called the Big Bang also abolished internal market restrictions and vacated its 100-year-old trading floor in favor of all-electronic operations.

Since then, deregulated trading has made markets more efficient, more fluid, and more popular around the world. The value of international shares traded on the London Exchange now totals more than £1 trillion (US\$1.6 trillion) annually - a third again more than its turnover in British shares. Indeed, the growth of global financial trading has been the most spectacular result of disembodied electronic markets. The value of cross-border share and bond trading has grown more than 5,000-fold since 1980, and \$1.4 trillion worth of foreign exchange is traded through the world's computers each day. The result: a continuous global plebiscite - not just on each company's business prospects, but also on each government's economic management.

Big Mac Index *A streetwise indicator of the comparative value of major world currencies.*

Invented by the London-based magazine *The Economist*, the Big Mac Index uses an edible icon of globalization as a kind of new economy gold standard. Its basis is the price of the signature McDonald's hamburger, converted into US dollars. Because the fast-food giant's production methods and pricing policies are standardized worldwide, the operating



assumption is that month-to-month price differences from country to country reflect local currencies getting out of whack with fundamental costs and economic efficiencies.

Union Bank of Switzerland does a purchasing-power version, comparing how long the average wage earner in various countries needs to work to earn enough money to buy a Big Mac. At the end of 1997, the longest time needed was just under two hours, in Caracas, Venezuela; the shortest, in Tokyo, was nine minutes.

Bionomics *Economies as ecosystems, not machines.*

Bionomics is a popular notion spanning a variety of new economy concepts, including evolutionary economics and complexity theory. Advanced by the Bionomics Institute, based in San Rafael, California, its core idea is that individuals, companies, and markets exist in a complex, adaptive web, in which technological advance is analogous to biological evolution.



Bloomberg "box"
Instant financial news, analysis, and real-time numbers, on demand 24 hours a day.

Bloomberg *The icon of real-time financial information.*

Michael Bloomberg, a former top trader at what was then Salomon Brothers, launched his New York-based private company in 1981 - a proprietary electronic network featuring instantaneous data and complex analytics for markets around the world. Along with competing versions from Reuters and Dow Jones Telerate, Bloomberg's "box" - in its latest incarnation, a sleek pair of LCD screens leased by brokerage houses and banks for \$1,160 a month - has become both a vital tool for managing money and a crucial synapse in the global economy's central nervous system. Meanwhile, Bloomberg itself, still privately held, has grown into a \$1 billion-a-year media giant, with tentacles in television, radio, and the Web.

Brand *The commercial equivalent of reputation.*

Brands are guideposts for consumers wandering through the new economy's ever more bewildering blizzard of choices. Long associated with ho-hum consumer products, branding is an antidote to commoditized production and brutal price competition. Even for behind-the-scenes technology companies, the idea of so-called trustmarks like "Intel Inside" may provide insurance against bolt-from-the-blue technological change (hello, IBM). Indeed, some management theorists argue that brands should be valued as an asset on corporate balance sheets - although none have yet been able to answer the all-important question of exactly how to place a value on this asset.



Capital *Stored value that can be used to produce more value.* In industrial economies, *capital* means machines or the money to buy them. Today the term just as often means knowledge, brands, intellectual property such as databases and software, or even vaguer notions like social capital – the trust that enables people to work together on a handshake rather than an expensively negotiated contract.

Electronic networks are fueling this process by increasing both the range of what can usefully be defined as capital and the speed with which it can move. The more kinds of capital there are – and the faster it moves – the greater the number of people who can share in the wealth. There is another term for this: economic growth.

Capitalism *A global economic system rooted in free enterprise, private property, and open markets; the way we all do business now.*

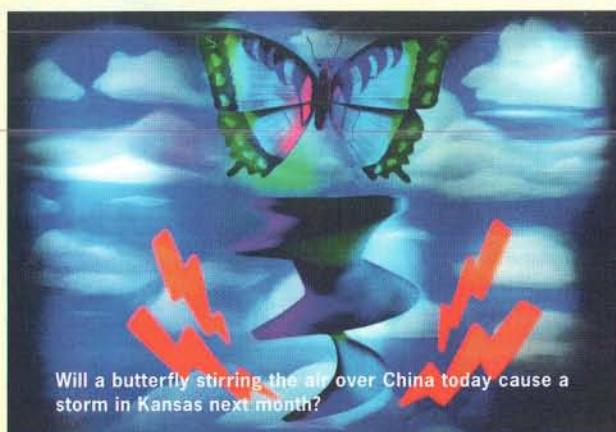
The heart of capitalism is a feedback mechanism, profit, which rewards activities that people appreciate sufficiently to pay for. Communism and even socialism lacked that, or expressed it imperfectly. And as technologies have grown more complex, capitalism's unparalleled ability to give people what they want – to match supply with demand – has largely obliterated its centrally planned rivals in a roar of economic growth.

Instead of socialism versus capitalism, the great debates of the 21st century are likely to pit interpretations of capitalism against one another. Indeed, battle lines are already being drawn – over trade, intellectual property, and equal access to technology.

Chaos theory *Ways to extract signals from noise.*

No equations can predict the growth of an oak tree – or, in the classic example, whether a butterfly flapping its wings can cause a storm a month later and 10,000 miles away. But computers can simulate such phenomena nonetheless by starting from a few simple rules that describe a process and then applying them thousands or millions of times.

Researchers are using this insight – and powerful computers – to understand everything from foreign-exchange markets to the movement of crowds. The models are not great at prediction. Even when the rules are understood, it's hard to capture all the factors that affect the evolution



of the real world. But the understanding they create may support people's own instincts and judgments. Even if they cannot predict prices, for example, traders hope that a new breed of computer simulations may at least predict when markets are heading for a bout of volatility.



Churn *Customer disloyalty.*

Ever faster innovation means more possibilities for customers to decide they don't really like your product after all – or to realize that someone else has a cheaper, faster, or better version. And the new economy's ever more efficient markets make it less costly – in money, time, or both – for consumers to make the move.

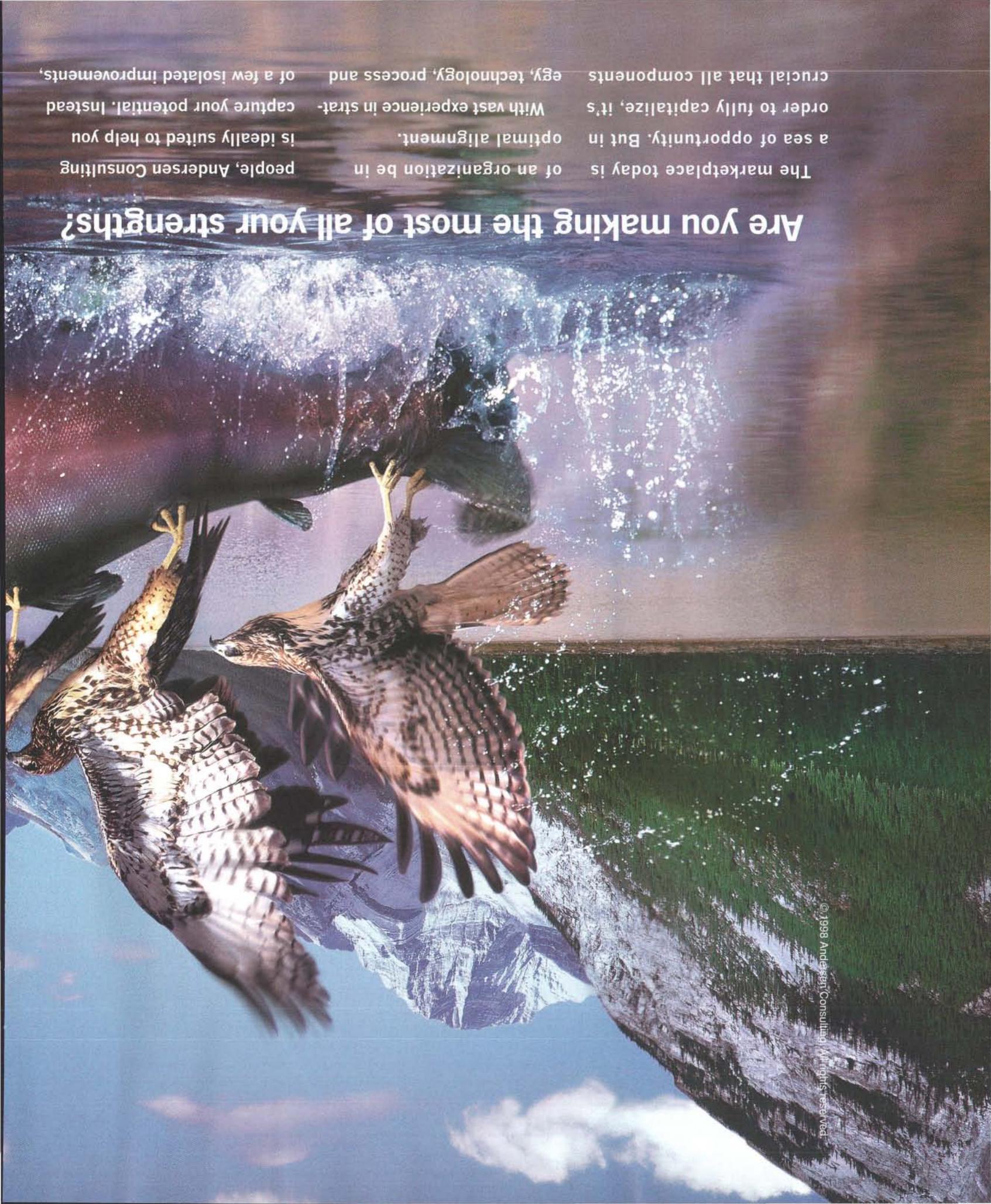
AOL learned all about churn when it developed a busy-signal problem late in 1996 and tens of thousands of expensively acquired customers bolted to less-popular rivals. Long distance phone services and credit card companies encourage defectors by spewing millions of pieces of junk mail – and, more recently, Internet banner ads – offering everything from reduced rates and frequent-flier miles to cash.

Internet retailing looks to be churn's next great frontier. Ecommerce pioneers are responding with new ways to build customer loyalty – personalized service, for example. But aggregators like Yahoo! and Excite make it pathetically easy to click from one e-shop to another – even as location, store layout, and other traditional tools for building competitive advantage vanish.

Commoditization *The process by which the complex and the difficult become simple and easy – so simple and easy that anybody can do them, and does.*

Commoditization is a natural outcome of competition and technological advance: people learn better ways to make things and how to do so cheaper and faster. Prices plunge and essential differences vanish – look at cheap PCs or mass-market consumer electronics.

The new economy puts commoditization into overdrive, speeding the flows of information, component parts, and finished products to the point where products can progress from idea to commodity seemingly overnight. The only real antidotes are barriers to entry –



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order to fully capitalize, it's

crucial that all components

of a few isolated improvements,

capture your potential. Instead

of a vast experience in stra-

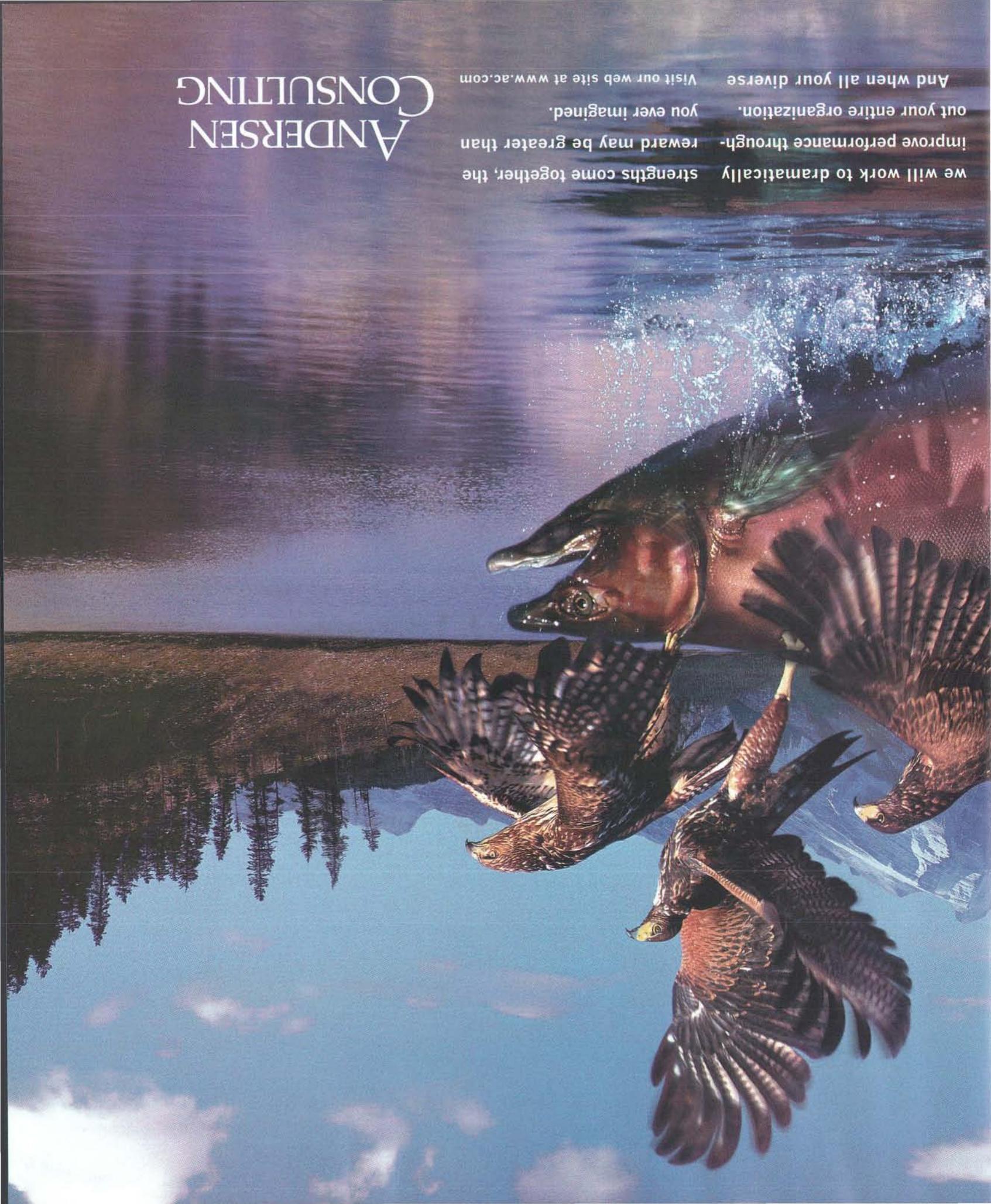
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say, a niche market too small to attract big competition. Or innovation sufficiently rapid to stay ahead of the pack. Or - if technology itself doesn't conspire to undermine it - an old-fashioned monopoly.

Community Aggregated people.

In the physical world, communities are typically groups of people - a town, for instance - held together despite their differences. Virtual communities are different: they're people held together by their similarities. The members of, say, a chat group about the TV show *Friends* are all interested in that subject and "talk" only about it. Rarely does anyone discover the things over which they differ.

But that same homogeneity gives virtual communities immense (though still mainly potential) economic clout. They bring likely customers together in one place, cheaply and easily - not a bad definition of a market. And, for consumers, they provide free help and service, along with valuable purchasing, market research, and R&D advice.

One problem is that virtual communities aren't bound together very tightly - no one even knows you're leaving. And there are too many other places to go if the one you're in starts unraveling.

Complexity theory *The study of how and why large systems behave in ways unexplainable by the sum of their parts.* Free markets are probably the best example of complex adaptive systems, as they're known by researchers at places like New Mexico's Santa Fe Institute. Players pursue nothing more than their own gain and interests. Yet the result - in theory - is the fairest possible distribution of goods and resources. Indeed, much of today's economics



is the practical study of these properties - figuring out when we can trust markets to produce fairness and when we need government to intervene.

Complexity theory, which originated in the study of natural environments, also helps explain how feedback loops can cause systems to stall. Whether it's outdated telecom restrictions or billion-dollar food subsidies, it's as easy to create vicious cycles as virtuous ones. The good news is that by helping to recognize the myriad ways in which systems can unintentionally screw up, complexity theory provides new tools for fixing them - and creates new respect for the ways they can unintentionally succeed.



Convergence Bits are bits.

It's the quintessential new economy idea: translate everything, from *Seinfeld* to your kid's homework, into the digitized 1s and 0s of computer language, then make it all available anywhere in the world via the Net. Big dollars are already being wagered on the prospect of TV and PC convergence - the idea that the two most powerful devices of the late 20th century can be merged into a single seamless information system. (Oh, and throw in the telephone, too.) It is a mesmerizing vision with profound ramifications for the corporate media landscape of the not-too-distant future. Stay tuned.

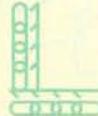
Coopetition Cooperation between competitors.

Altruism doesn't have to be the opposite of self-interest. Sometimes - when trying to create a new market or hedge the risks of an expensive innovation - it can be a way to get what you want.

Coopetition - alliance, in the case of noncompetitors - is especially common in the computer industry, where consumers want to know in advance that a broad range of companies will support a given technology. Companies cooperating helps such markets grow faster, without requiring prolonged periods to shake out competing technologies. It also helps focus scarce resources - though not necessarily on what is ultimately the best technology.

Coopetition often involves companies agreeing not to battle in one market even as they fight like dogs in others: witness the current "grand alliance" of Sun, IBM, Apple, and Netscape, which is supporting the open programming language Java to undermine Microsoft's market power. More commonly, companies will compete on actual products even as they cooperate on technical standards, sacrificing a degree of independence to increase the odds of success for the technology as a whole. Look at the huge success of American Airlines in opening its Sabre reservation system to competing carriers.

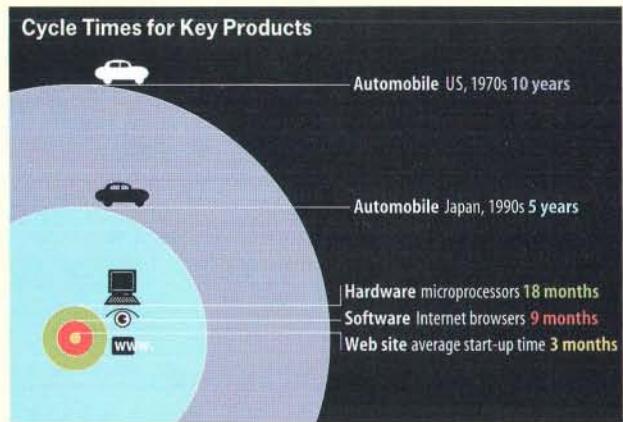
Needless to say, coopetition makes antitrust authorities nervous. There is an old-fashioned word for competitors who agree not to compete - *cartel*, with its overtures of



price fixing. Today's regulators appreciate the theoretical advantages of coopetition, but in practice they still want to be sure that they can distinguish it from old-fashioned collusion. And as Microsoft's on-again, off-again antitrust investigation shows, separating new ways of doing things right from old ways of doing things wrong is far from easy.

Cycle time *How long it takes to bring a new product to market or to upgrade an existing one.*

Prior to the industrial revolution, cycle times could often be measured in centuries. They've been declining ever since, pulled along by ever larger and ever hungrier markets and pushed by increasingly supple technology. Detroit



automakers could stretch a basic model change over a decade; competition from the swifter Japanese changed that. Today exhausted Web developers talk about "Internet time," where the cycle time gets close to zero - essentially, nonstop continuous change and innovation.

Data mining *Extracting knowledge from information.*

The combination of fast computers, cheap storage, and better communication makes it easier by the day to tease useful information out of everything from supermarket buying patterns to credit histories. For clever marketeers, that knowledge can be worth as much as the stuff real miners dig from the ground.

More than 95 percent of US companies now use some form of data mining - often nothing more than mailing lists, but increasingly the more sophisticated psychographic profiles of potential customers that make privacy advocates shake. It's a perfect hot-button political issue: Whose data is it, anyway?

Decentralization *Decisionmaking moved from the center of an organization to the edges.*

What do you expect when companies give every employee a computer, a telephone, and an Internet connection?

Decentralization is an inevitable consequence of an information economy, where communications and processing power are cheap, time is short, and enterprises span the globe. And that means empowering decision-makers down to the lowest level.

Managers count on those same information networks

to help them keep an eye on what workers are up to (including who's wasting time playing *Quake*). But decentralized managers also face a novel question: To what extent can they still consider themselves to be in charge?

Deflation *Falling prices.*

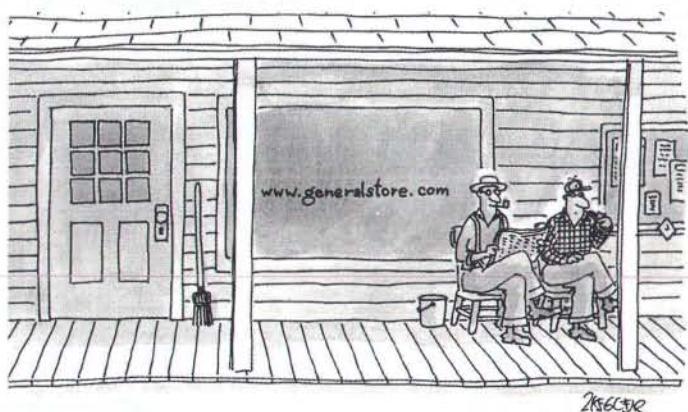
Some otherwise reasonable people worry that the ever more efficient new economy will bury us in an avalanche of goods - a global glut. Their fear is a replay of the 1930s: tumbling prices, vaporized profits, supply running far ahead of demand.

Deflation is indeed happening in a few markets - look at the price of computer chips or long distance phone calls. But the price of many other things is definitely not falling (Silicon Valley real estate, for starters). The price of the average car is stable or even rising - though what you get is a vastly superior product.

What technology undeniably has done is raise the speed of innovation in the economy. That means certain industries will suddenly find themselves faced with falling prices and slumping demand - not because the whole economy is going into a deflation-induced slump, but simply because somebody else has come up with products and services that people would prefer to buy. It's unhappy for anyone on the downside of an innovation cycle. But far from crippling the economy, that sort of change is precisely what produces continued innovation and growth.

Deregulation *What happens when governments have to compete for capital and labor.*

Opening up telecom to competition helped kick-start the new economy. And as the resulting economies become ever more fluid, government intervention in economic processes - or the lack of it - is becoming simply another factor of production. In Walter Wriston's famous phrase, "Money goes where it is wanted and stays where it is well treated." So, bureaucrats be warned: Regulate at your peril.



Digital signatures *The lifeblood of electronic commerce and citizenship.*

Digital signatures - John Hancocks for electronic documents - are a key tool in making cyberspace a place where

people can do things besides hunt down information. Like their pen-and-ink counterparts, they establish identity and so can also be used to establish legal responsibility. Unlike real-world signatures, they can also establish the complete authenticity of whatever they are affixed to – in effect, creating a tamper-proof seal.

Governments from Germany to Utah have given digital signatures at least the same legal status as the paper kind. But electronic autographs have also become embroiled in the general cryptography debate. Security services don't want people – criminals, to be specific – using strong crypto. Unfortunately, the same technology is also needed to create forgery-proof signatures. And so far – at least in the United States – the police aren't giving ground.

Discontinuity *Change so all-encompassing that it transforms even the standards by which change is measured.*

Discontinuities are bolts from the blue – most often technological, but sometimes social or political (wars, for instance). Sudden shifts in the competitive landscape are not unique to the new economy – ask your local horse-and-buggy salesman. But accelerating innovation makes them more frequent – and, for those in the corporate trenches, sometimes more dramatic.

The challenge for companies is to adapt – many don't. In a famous example, US railroads failed to realize that their real business was something bigger – transportation. They got trashed by the introduction of long distance trucking. A more recent example: Microsoft's (near) dismissal of a technological flash in the pan called the Internet.

Diseconomies of scale *Too many cooks spoil the broth.*

In information work, being big and musclebound often means rising production costs and falling productivity. Fred Brooks, now a professor at the University of North Carolina at Chapel Hill, first documented the phenomenon when he analyzed the development disaster that became IBM's breakthrough operating system, OS/360. Brooks, who was in charge of the project, found that the more people he put on the project, the more it lagged behind schedule. With hindsight he realized that trying to bring the newcomers up to speed took more time and effort than they could contribute to the project – not to mention exacerbating the confusion caused by ever-lengthening chains of communication.

Bill Gates has read Brooks's book, *The Mythical Man-Month*. That's why Microsoft, for all the billions of dollars in its war chest, keeps its development teams small.

Disintermediation *Cutting out the middleman.*

As networks connect everybody to everybody else, they increase the opportunities for shortcuts. When you can connect straight from your desktop to the computer of your broker or bank, stockbrokers and bank tellers start to look like overpriced terminal devices.

Disintermediation first gained momentum in financial markets when customers began forsaking savings banks for their stockbrokers' money market accounts – denying

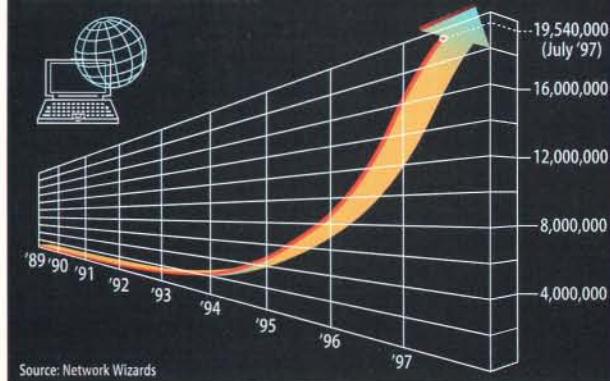
banks the opportunity to make a nice return by investing the funds in money markets themselves. Now entire swaths of the economy are vulnerable: stockbrokers, real estate agents, anybody who picks up a phone for a living. And maybe generic clothing stores, computer resellers, and record shops, too – thanks in part to the cheap, convenient, and increasingly universal distribution networks otherwise known as FedEx and UPS.

In practice, though, disintermediation more often means changing jobs, not eliminating them. And, in the process, it can create opportunities for new and different middlemen – look at online bookseller Amazon.com and stealth retailers like CUC International. As networks turn increasingly mass-market, everyone involved in sales is playing a duck-and-weave game of disintermediation and reintermediation. To the winner go the customer relationships.

Distributed systems *Cooperation by another name.*

Distributed systems originated in the computer industry, where – to the surprise of many – collections of medium-powered computers sharing work often outperformed even high-powered monolithic mainframes. Like decentralization, distributed systems work by putting decision-

Growth of Internet Hosts



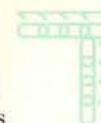
making where the information is, shortening chains of command and speeding response. In doing so, they are particularly well suited to very large applications – the Internet, for instance, whose 91 million computers make it by far the largest distributed system ever created.

Economies of time *Faster is better.*

Being first to market brings huge advantage in an information economy. By learning your way of doing things, customers make a mental investment in your product – a powerful hold in an otherwise mostly friction-free world.

More generally, markets based on weightless bits moving at the speed of light tend to reward quality rather than mere quantity. As physicist Freeman Dyson has observed, "Never sacrifice economies of time for economy of size." Which is why even Microsoft worries about cycle time.

Parts II and III of Wired's Encyclopedia of the New Economy will appear in Wired 6.04 and 6.05.



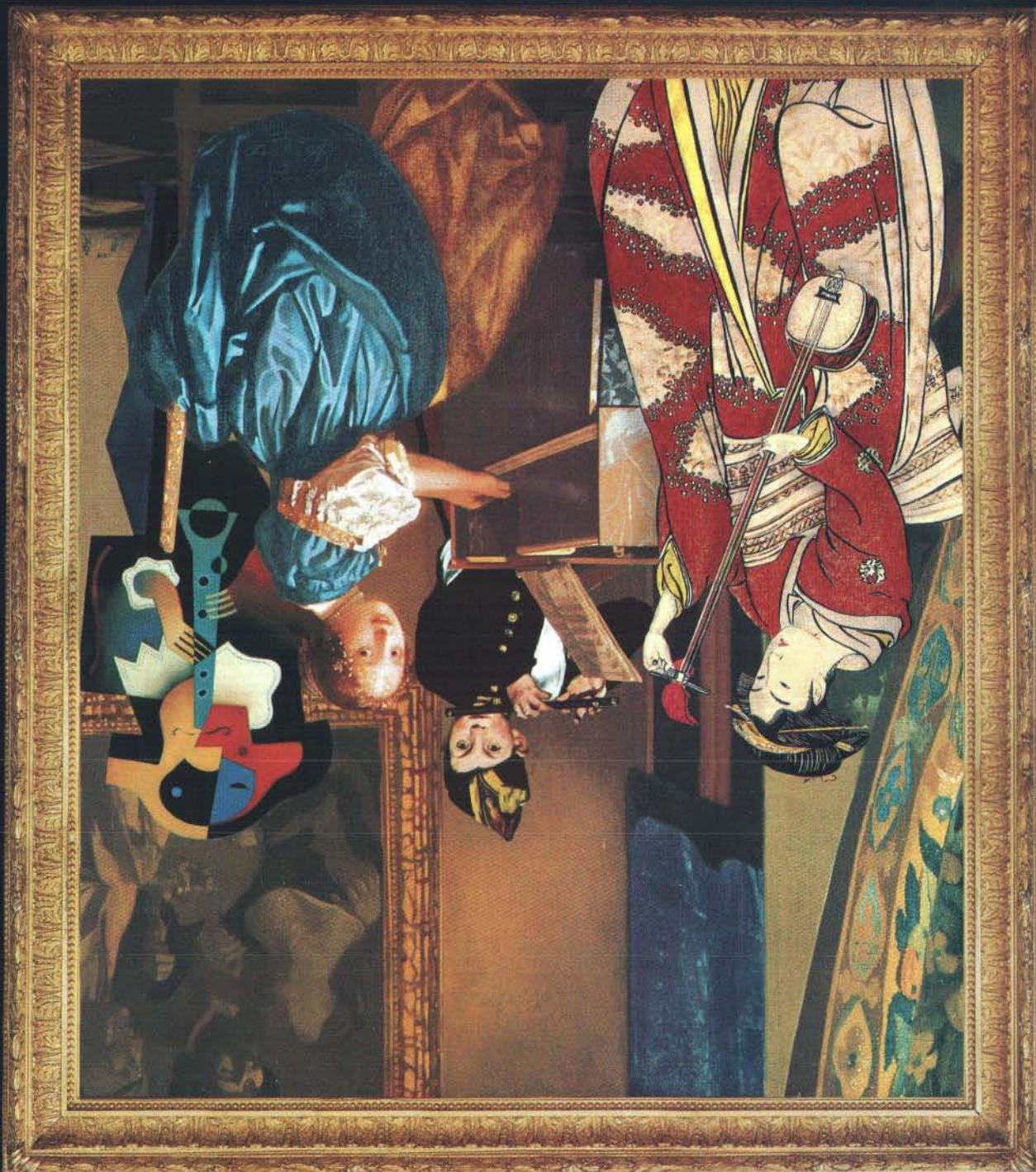
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Cyberbeats

Forty years ago, the literary maelstrom of Kerouac, Ginsberg, and Burroughs paved the way for the digital revolution.

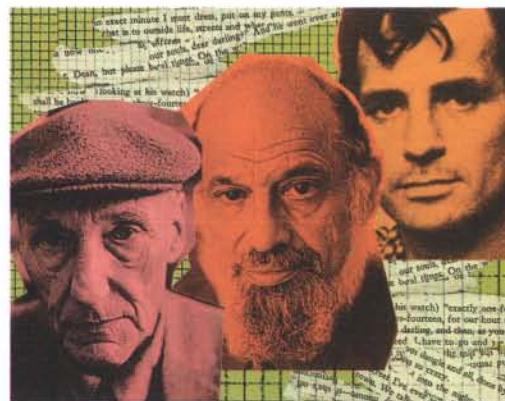
By David Batstone

Allen Ginsberg told death to wait in line. He had some unfinished business with the morality police. Poet, pop star, political activist, spiritual avatar, all crowded onto his résumé. And here was Ginsberg, at age 70, lying prone on his bed in San Francisco's Hotel Triton, delivering what would turn out to be his final extended interview. Within four months, the congestive heart failure that had chronically ailed him would take his life.

Ginsberg wheezed and coughed his way through a retrospective of the Beat movement that surged through the American literary scene in the 1950s. Other Beats often dubbed him the great communicator of their ideal of cultural freedom, but he spoke with a humility and enthusiasm that would suggest he was simply a fan.

At the slightest mention of censorship, however, Ginsberg's demeanor changed dramatically. He elbowed his upper body erect off the hotel mattress and breathed fire: "The law infringes on my free market, yet it's the very free-market bullshit artists that are doing this. What hypocrites!"

Ginsberg was never one to take restrictions on his free expression lying down. In 1957, US Customs Service agents impounded his London-published poetry collection *Howl* on charges of obscenity. The ensuing court battle catapulted the Beats off the pages of obscure literary rags and into the national spotlight.



From Burroughs's "kaleidoscope of vistas" and Ginsberg's "many eyes" to Kerouac's "language sea," streams of consciousness now sweeping the planet started with the Beat Generation.

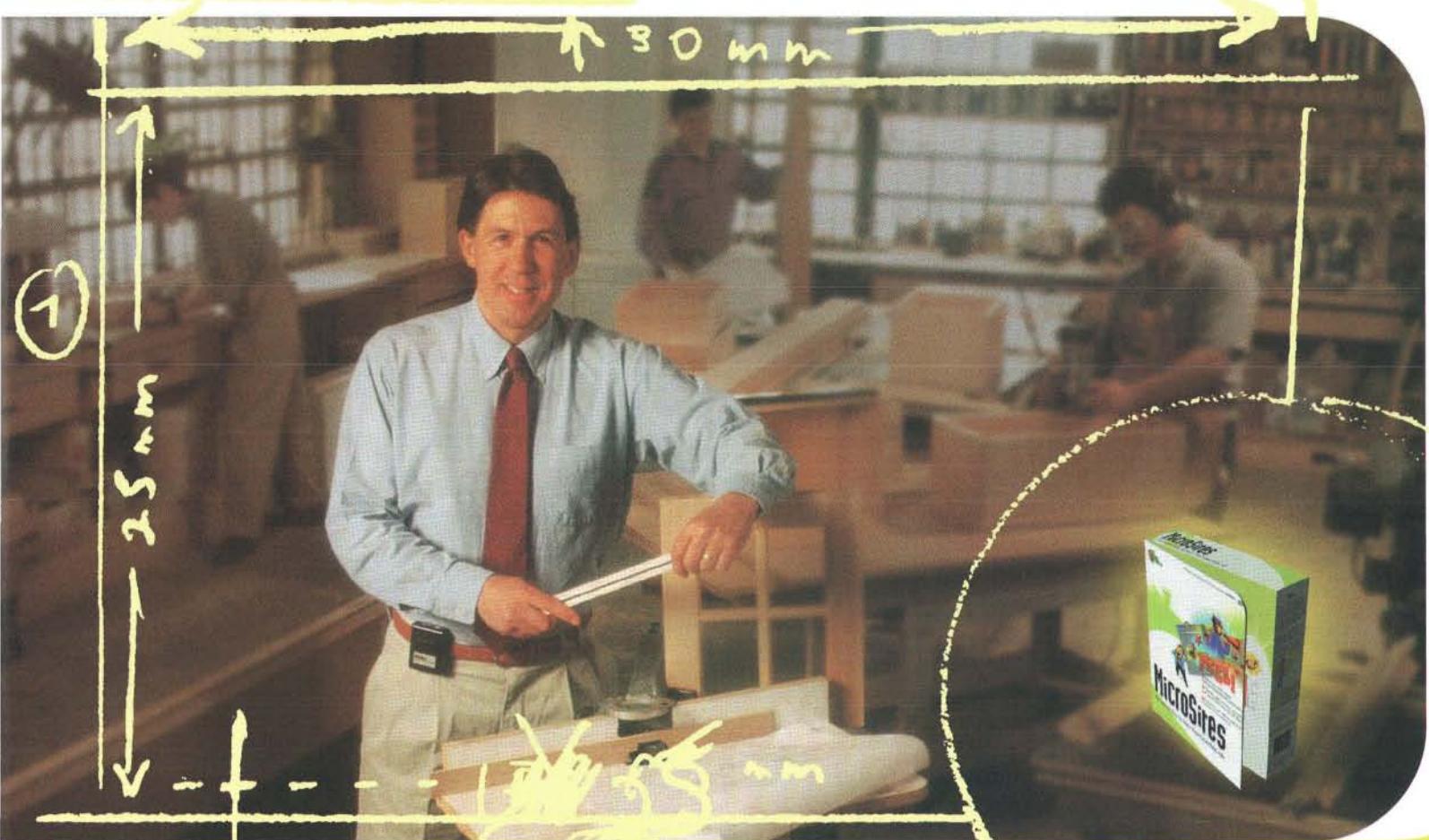
An unrepentant Ginsberg maintained to the end that state censorship degrades democracy. "It's all about mind and body control for the sake of power," he rasped, his legs now dangling over the edge of the bed. "And today the fight continues over the Internet."

The Beats and the digerati? The art of communication sure brings together odd companions. Ginsberg's link, however, surpasses poetic hyperbole. While the Beats' writing method and brazen lifestyle were deemed downright quirky in the 1950s, the collective aesthetic of Jack Kerouac, William Burroughs, Gary Snyder, Michael McClure, Ginsberg, and friends portends streams of consciousness that emerge with remarkable clarity in the digital age.

It all starts, and ends, "on the road." Dean Moriarty and Sal Paradise, the primary characters in Kerouac's legendary novel, search for something they can believe in and, hell, all the ecstasy and transcendence they can stand along the way. Kerouac places Dean and Sal into full contact with the unknown and unfamiliar, and flashes of revelation appear to them from the most unlikely sources. They discover by trip's end that the mystery of the open road lies not in any particular destination, but the perennial drift toward connection.

That message would fit comfortably on the dust jacket of Sherry Turkle's latest who-are-we-now treatise, *Life on the*

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Screen: Identity in the Age of the Internet. The MIT professor tracks personal identity in the digital age and concludes that we invent who we are as we move in and out of social encounters and adapt to a variety of social roles. We build a sense of reality out of the associations we make. Turkle identifies the Net as "a significant social laboratory for experimenting with the constructions ... of the self that characterize postmodern life."

Kerouac and Turkle write out of vastly different social contexts, of course. Kerouac was rebelling against a strongly imposed view of the self. Astute cultural critics of the '50s depicted postwar America as a one-dimensional society run by "organization men" who produced mass culture for the consumption of "lonely crowds." Any variance from the conformity was akin to treason. "What is good for GM is good for America" ran the slogan that dictated behavior ranging from the economic to the personal. Kerouac and his peers challenged that stability with their provocative tales of

self-discovery that openly violated sexual, racial, and cultural mores.

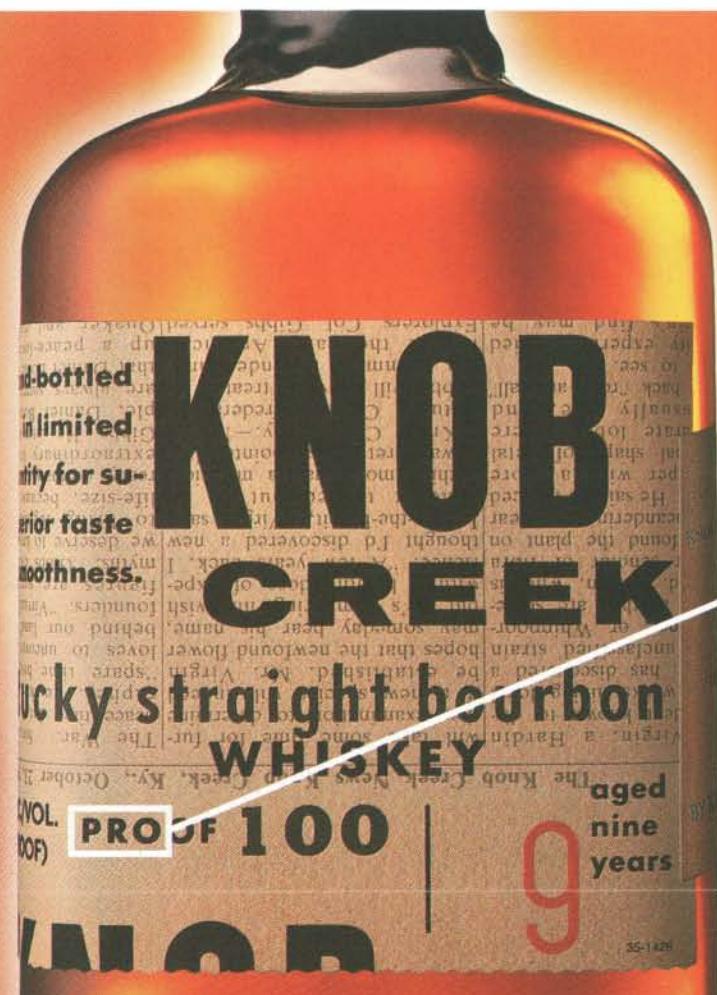
In Turkle's postmodern world, many of the institutions that once bound people together – the bank on Main Street, a neighborhood church, a union hall – have now become objects of nostalgia. The places we meet others today, she writes, tend to be much more transitional, offering services and relationships that address small parts of our lifestyles. The relationships we build in work, family, school, and neighborhood overlap only slightly. Postmodern individuals endlessly recycle through communities to which fragments of their identities are bound.

In *Life on the Screen*, Turkle relates the story of Gordon, a man who was raised in two homes after his parents divorced while he was still in grade school. He spent winters with his mother in Florida and summers with his father in California, and Gordon was deeply hurt that his mother rented out his room whenever he went off to California. His sense of displacement

continued after he went to college, only to drop out a year later upon realizing that he could succeed at computer programming without a formal education. Turkle demonstrates how Gordon's role-playing in several MUDs helped him find integrity and consistency in the diverse "personae" he had been simultaneously raised to be.

Likewise, Kerouac's characters struggled to find their individuality within the invented consensus of a mass culture. Hungering for fresh sources of information, they slipped into the worlds of others and began similar role-playing experimentation. Hobos and racial outcasts intrigued Kerouac, while Ginsberg gravitated toward sexual outlaws and Burroughs befriended drug addicts and criminals. Raised in middle-class malaise, these writers desired to see a world that was set free from control and conformity.

Inspired by the rawness of his encounters, Kerouac changed his writing method to mirror the movement of time. Writing was dead, he argued, once it was made to bow before prescribed rules, narrow selectivity,



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punctuation, and revision. He wanted his writing to "bop" as spontaneously as the improvisational saxophone scat of Charlie Parker or the action painting of Jackson Pollock. Exhausting the forms of language would give him, he hoped, new insights into how the world might be reassembled. He likened his writing method to "swimming in a language sea," an unintended yet colorful description of hypertext for a digital generation.

Starting with *On the Road*, Kerouac recorded whatever impressions or memories spilled out of his mind, deliberately repressing his obsessions for finding the "right" word or idea. His motto: first thought, best thought. He quickly ran into an obstacle, however. His flow was interrupted each time he had to feed a new sheet of paper into the typewriter. To remain uninterrupted, he typed on long rolls of teletype paper. Over the course of only three days in 1953, he wrote *The Subterraneans*, a barely fictionalized account of one of his love affairs.

Kerouac felt that he had stumbled on "the only possible literature of the future" and foresaw a day when the means of communication would facilitate not only spontaneous prose, but a more immediate exchange of ideas as well. While his insights are uncannily prescient of the arrival of email, at the time Kerouac could only imagine its advent in science fiction terms, naming it "space age prose." "It may be they won't be reading anything else but spontaneous writing when they do get out there, the science of language to fit the science of movement," Kerouac wrote.

pithy phrase captures the spirit of his list: "Something you feel will find its own form."

Kerouac's "essentials" read like a survival manual for the denizens of electronically mediated virtual communities. Cyberspace pundit Allucquère Rosanne (Sandy) Stone, in fact, suggests that success in online encounters requires the ability to perform "lucid dreaming in an awake state." Stone, who directs the University of Texas Advanced Communication Technologies Laboratory, thinks that people who participate in MUDs and other simulated environments gain interactive ways of processing information

Kerouac's "essentials" for spontaneous prose read like a survival manual for the denizens of electronically mediated virtual communities.

To help Ginsberg and Burroughs appreciate his transformation as a writer, Kerouac prepared a laundry list of attitudes and techniques he considered essential for spontaneous prose (see sidebar, page 122). One

that enhance perception in physical environments as well. Their imaginations do not stop firing once they leave their avatars. Like the traveler who comes home from an immersion in a foreign culture, the virtual

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expatriate comes back to the real world with new perspectives on what once was not only too familiar, but also seemed incapable of change.

Stone's belief that MUDs permit the growth of more fluid and dynamic personae resembles the "language of movement" Kerouac once imagined. "The soul or some improbable avatar routinely travels free of the body, and a certain amount of energy is routinely expressed in managing the result of its travels," comments Stone in her book *The War of Desire and Technology at the Close of the Mechanical Age*.

The Beats, of course, turned to fiction and poetry as their tools for creativity. Writing gave them license to blur lines and make associations that bent the rules of publicly ordered social life. Connections that made no sense (or were not allowed to exist) in the real world took on a life of their own in imaginary environments. Even when their subject matter was autobiographical, which it often was, the Beats usually danced behind the masks of their characters and tropes. Kerouac, for example, detailed in each of his novels the names and places of his daily encounters, yet freely fictionalized

brazenly claimed that its words could have worked just as easily in any order. His description of the ideal presentation of the book has more the feel of a Web page than hard copy: "The book spill off the page in all directions, kaleidoscope of vistas, medley of tunes and street noises, farts and riot yipes and the slamming steel shutters of commerce."

The Beats' collective literary philosophy evoked a furious backlash from many public intellectuals. Norman Podhoretz delivered one of the more biting critiques in his influential *Partisan Review* essay, "The Know-Nothing Bohemians." In effect, Podhoretz's diatribe resembles the kind of suspicion that the print media today frequently direct toward the Internet. Early last year, for example, *The New York Times* cautioned its readers: "Partly owing to free-speech protection, the Internet lacks a quality-control mechanism to separate fact from hyperbole or from outright falsehood...." Podhoretz, for his part, warned that the Beats' faith in human passion and celebration of "incoherence" was sure to lead to moral breakdown, particularly among America's youth.

in chaos, where patterns emerge but last no longer than the period for which they are relevant or meaningful. If nothing is fixed or permanent, creativity can run amok. Keeping up with the flow of reality, then, demands constant awareness. Philip Whalen, then Beat writer and now Buddhist monk, succinctly articulated the spirit of the Beats in his poem "Sourdough Mountain Lookout":

*What we see of the world is the mind's
Invention and the mind*

*Though stained by it, becoming
Rivers, sun, mule-dung, flies -
Can shift instantly*

A dirty bird in a square time

These "material-symbolic-psychic" connections lie at the heart of Donna Haraway's contemporary theories of technoscientific culture. Haraway, a professor in the History of Consciousness program at the University of California at Santa Cruz, shares the Beats' passion to affect the language and concepts upon which a worldwide web of relationships depend. Her ultimate interest is to pursue "which connections matter, why, and for whom?"

Haraway finds it ironic that technoscience has abrogated to itself the right to define truths that are fixed and universal. The early purveyors of the scientific revolution, to the contrary, sought to make knowledge contingent on experimentation so as to avert the terrors of holy civil wars and arbitrary monarchs. But somewhere along the way facts and self-evidence became the tools for a modern form of mental tyranny.

Haraway believes hypertext is a useful metaphor for describing what really happens in the production of knowledge. In her latest book, *Modest_Witness@Second_Millennium.FemaleMan©_Meets_Onco-Mouse™*, she spotlights the Mosaic browser - as well as its offspring and competitors - as a primary medium of global information dispersion during the 1990s. She emphasizes that the knowledge Mosaic represents is vital for the distribution of valuable goods like freedom, justice, well-being, wealth, skill, and knowledge. "Computers' cause nothing," Haraway admits. "But the human and nonhuman hybrids troped by the figure of the information machine remake worlds."

In 1959, Burroughs revealed the dark rationale of one-way telepathic control: "Power groups of the world frantically cut lines of connection."

these slices of reality whenever it served the movement of the story.

While other Beats followed Kerouac into a spontaneous prose, Burroughs developed a montage style of writing that he believed more faithfully mirrored the process of human perception than did representational writing. Utilizing a crude cut-and-paste method, he did not so much write a book as design it. His stated goal was to impose neither plot nor continuity, but splice together as many images as possible simultaneously.

Burroughs was frustrated by the inherent limitations of communicating information solely through a two-dimensional sheet of paper. He astonished readers with his preface to his 1959 novel *Naked Lunch*, which

Podhoretz missed the subtlety of spontaneous prose, but he rightly sensed the Beats' general suspicion of intellectualism. While the industrial world touted empirical reason as the sole path to the truths that really matter, the Beats placed their trust in the dawn of a new age that would value intuition and imagination as equally critical to the production of knowledge. They believed that reason alone was incapable of keeping pace with a world of rapidly changing truths.

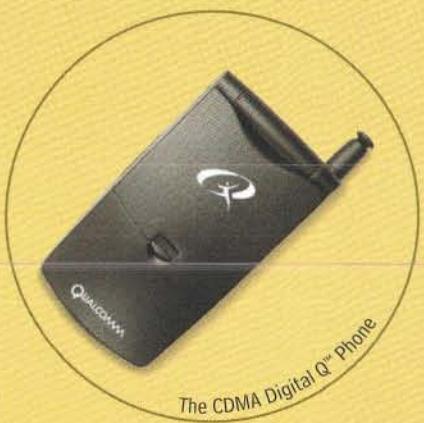
One thought logically following another and centrally organized fit a mass consumer, a mass media, and a mass political structure. The Beats insisted that the new consciousness be discontinuous. They reveled

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Mosaiclike browsers provide the stage for making hypertext and hypergraphic connections. The actual results, however, depend on daily negotiations. Pathways through the Web therefore are not predetermined, but are filled with agendas, conflicts, and partial testimonies to diverse experiences. Haraway suggests that despite our mystification of technology, the most important factors in the information game – regardless of whether it pertains to science or polities or both – are the “enrollments” (who shows up) and the “hybrids” they produce in their interaction.

The Buddhist notion of “emptiness,” which appears regularly in Beat writing, is in many respects parallel to Haraway’s idea of hypertext. The ability to simulate and interact with the moment was in their mind more important than calculation and repetition of that reality. “Emptiness implies a common space, yet not a common mind with archetypes and messages running back and forth,” explained Ginsberg. “Just as the Internet represents a collective body of information, creativity is distributed throughout the network.”

Asked whether John Perry Barlow’s depiction of the Net as “hardwiring the collective consciousness” (see “A Globe, Clothing Itself with a Brain,” *Wired* 3.06, page 108) might resonate, Ginsberg deferred. “It sounds like Barlow may be trapped in some monotheistic hierarchization of consciousness: one central repository, almost like a god, but in this case more like a noosphere.” Ginsberg then immediately rattled off a phrase from a favorite poem, “There are no hierarchies, only many eyes to be looked out of.”

Given their historical context, the Beats were ever wary of efforts to collectivize creativity, be the motivation utopian or fascist. Many of the Beats found solace in Buddhism for the very reason that it offered channels for linking the solitary mind to a deeper consciousness of the universe, without causing one to lose oneself in groupthink.

Limits on communications in 1950s America reduced politics, reason, and ethics to a narrow technoscientific project called the Cold War. The web of secrecy ran from the bedroom to the top of the government, tightly regulating the kinds of intercourse that were permitted in the private and public

spheres of society. In this claustrophobic environment, the writings of the Beats begged for candor about sexuality, politics, drugs, and money.

Burroughs exposed the dark side of this state regimentation in *Naked Lunch*, his drug-soaked parody of social control. The “Senders” are a scientific-industrial élite who gather at a National Electronic Conference in order to map out the future of the social order. They pass a legal mandate requiring every surgeon to install a miniature transmitter into the neural pathways of the citizenry, so that subjects will send messages of their internal feelings and thoughts back to the State. But the Senders decide that a citizen must never receive a message, lest he “recharge himself by contact.” Burroughs later reveals the Senders’ rationale for one-way telepathic control: “Power groups of the world frantically cut lines of connection.”

Ginsberg was convinced that the struggle for the free exchange of information was far from over in the digital age. “The key to hierarchical power is the maintenance of secrecy,” he rasped in a weak voice.

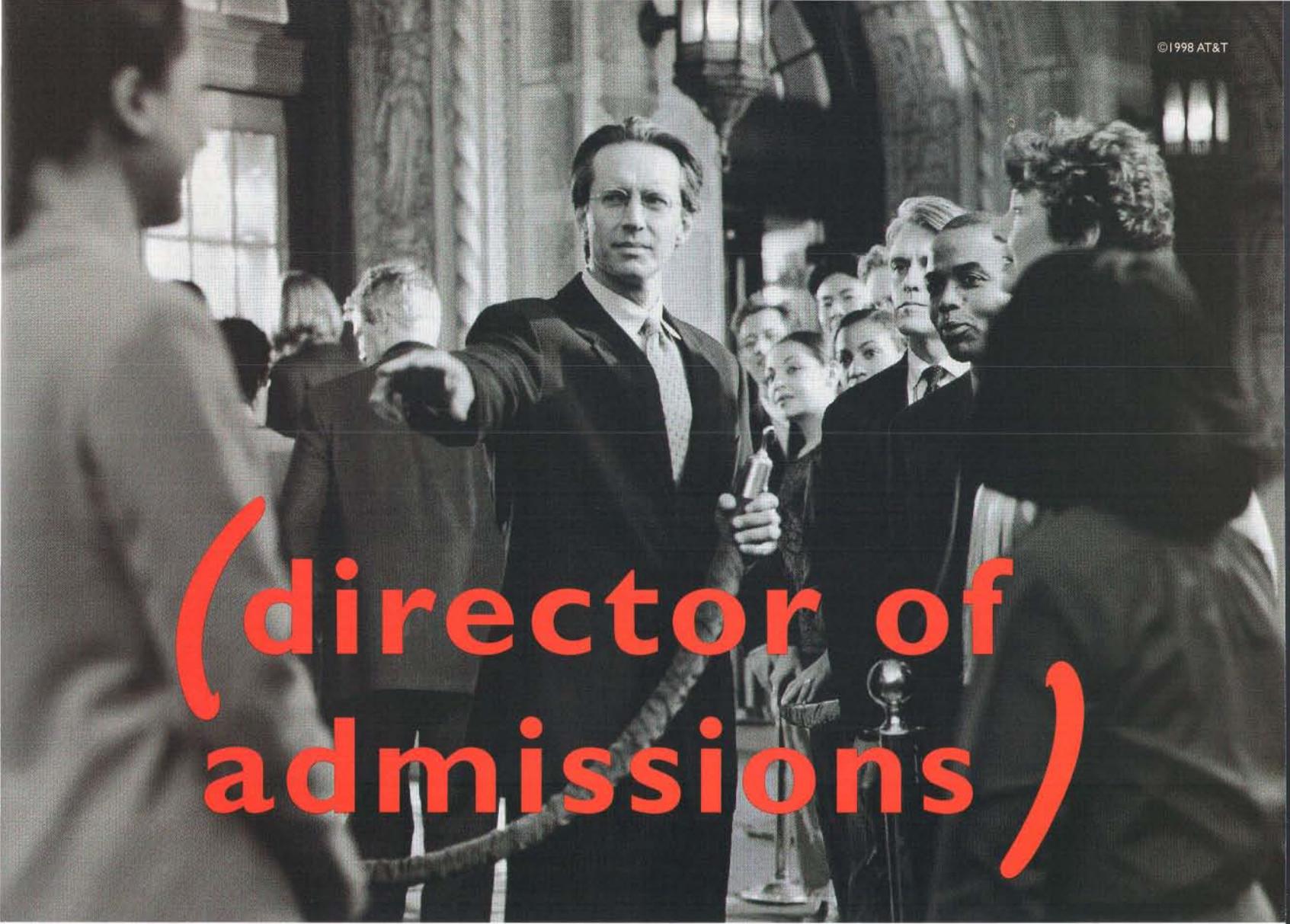
His remarks extended far beyond censorship to address the very exercise of political power in the age of communications. After four decades as a public artist, he had reached the conclusion that the health of a democratic society required open and accessible information. “Why should we have classified documents?” he wondered aloud. “I’m happy for the government to know everything about me as long as I have access to everything that is going on in their lives and among their political alliances.”

Ginsberg claimed that such candor lay at the very heart of what it meant to be a “Beat.” While tons of ink have been spilled trying to define the significance of the name, he suggested that Kerouac got it best way back in *On the Road*: “Everything belongs to me because I am poor.” ■ ■ ■

David Batstone (batstone@globalcafe.com) is a professor of social ethics at the University of San Francisco. He is host and executive producer of BusStop RadioNet Productions, broadcast weekly on National Public Radio.

Kerouac’s Essentials of Spontaneous Prose

1. Write on, can’t change or go back, involuntary, unrevised, spontaneous, subconscious, pure
2. Scribbled secret notebooks, and wild type written pages, for your own joy
3. Submissive to everything, open, listening
4. Be in love with your life every detail of it
5. Something that you feel will find its own form
6. Be crazy dumb saint of the mind
7. Blow as deep as you want to blow
8. Write what you want bottomless from bottom of the mind
9. The unspeakable visions of the individual
10. No time for poetry but exactly what it is
11. Visionary tics shivering in the chest
12. In tranced fixation dreaming upon object before you
13. Remove literary, grammatical and syntactical inhibition
14. Like Proust be an old teahead of time
15. Telling the true story of the world in interior monolog
16. Work from the pithy middle eye out, from the jewel center of interest, swimming in language sea
17. Accept loss forever
18. Believe in the holy contour of life
19. Write in recollection and amazement of yourself
20. Profound struggle with pencil to sketch the flow that already exists intact in mind
21. Don’t think of words when you stop but to see picture better
22. No fear or shame in the dignity of your experience, language, and knowledge
23. Write for the world to read and see your exact pictures
24. In Praise of Character in the Bleak inhuman Loneliness
25. Composing wild, undisciplined pure, coming in from under, crazier the better
26. You’re a Genius all the time
27. Writer-Director of Earthly Movies produced in Heaven, different forms of the same Holy Gold



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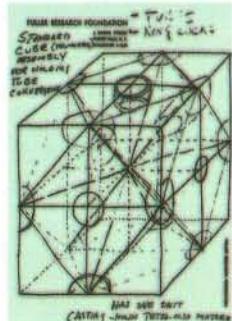
Age of Interpretation

Online Synergy

Not to be confused with *Dianetics*, L. Ron Hubbard's occultish work that spawned *Scientology*, *Synergetics* is the opposite of that disinfo stream. The magnum opus of the late R. Buckminster Fuller, it is nothing short of an explorer's guide to the workings of our universe.

Synergetics is a thorough investigation into both physical and nonphysical reality. It's easily one of the most exceptional books of this century.

However, *Synergetics* is now long out of print. Fuller's estate



A Fuller comeback.

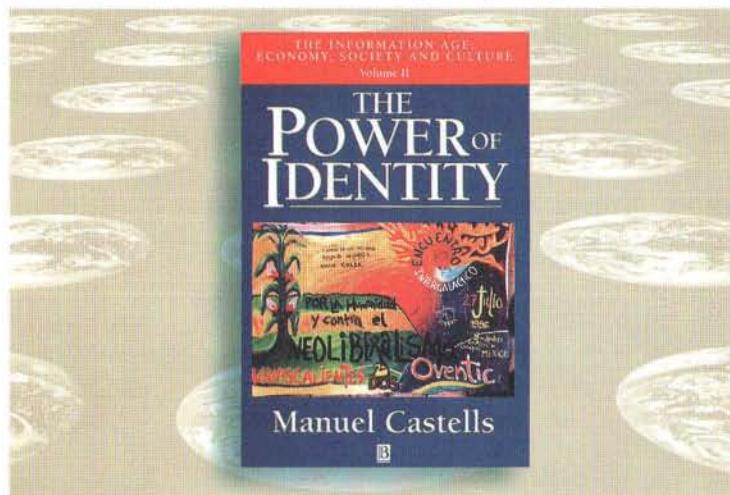
recently agreed to put both volumes online, where virtual communities have grown. It is interpreted and explored; Kirby Urner's thriving *Synergetics*-L mailing list is a prime example.

Fuller's *Synergetics* may not be taught in schools anytime soon, but the amorphous Net is bringing his vital lifework to the world. — Michael Stutz

Synergetics: Explorations in the Geometry of Thinking, by R. Buckminster Fuller; free. Macmillan Publishing Company: on the Web at www.servtech.com/public/rwgray/synergetics/synergetics.html.

Get ahold of Manuel Castells's three-volume work, *The Information Age* — a must-read with its more than 1,200 pages of fact-packed, lucid prose. Castells explores the social significance of information technology and examines the remapping of global geography in the information age according to what he calls "the space of flows" — not location in space, not the change of location, but a higher derivative "location" of value based on the volume of traffic. Ye shall know them by their email volume and their FedEx bills.

Castells is the intellectual heir to Hegel. Academics will be suspicious of him for his comprehensive reach. He's read *everything*! But these works, as he says, are not about books but about the world as we are needing to reinterpret it. While volume one covers the communications technologies that are pulling us, globally, together, volume two focuses on the forces that are pulling us apart: the identity



What puzzles are posed by our transition to informationalism?

politics of feminists, environmentalists, and ethnic "nationalists" of various stripes. Volume three explores those who are disenfranchised by digital illiteracy — "the black holes of informational capitalism."

Turning Marx's eleventh thesis on Feuerbach on its head ("The philosophers have only interpreted the world in various ways. The point, however, is to change it," said Marx), Castells concludes his magnum opus: "In the 20th century, philosophers have been trying to change the world. In the 21st century, it is time for them to interpret it differently."

Perhaps you're at peace with an information society that privileges the quick over the tired. But after this read, you may long for a new edition of *The Federalist Papers*, one that addresses the questions of justice in a way that takes account of our leaving the agricultural and industrial eras to inhabit an information age where delivering good bits doesn't always add up to producing good. — Jay Ogilvy

The Information Age: Economy, Society, and Culture, by Manuel Castells: each volume US\$69.95. Blackwell Publishers: (800) 216 2522, on the Web at www.blackwellpub.com/.

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Video Effects

Back in Yellow

In the winter of 1989, when Fox first aired *The Simpsons Christmas Special*, I started recording the shows, taking care to cut out the commercials. Now, eight years later, I have more than 36 tapes of *Simpsons* episodes.

Unfortunately, all my work has recently become moot. Fox Home Entertainment has released six early *Simpsons* episodes on video. Available individually or as a boxed set of three, each of *The Best of the Simpsons* tapes contains a pair of shows from the first year, as well as an original short from *The Tracey Ullman Show*.



Homer at his best.

While you can see the show every day, thanks to reruns, the versions being shown in syndication have a couple minutes clipped out for more commercials. Not so with these videos; all the jokes are here.

With any luck, there'll be more of this series. There's still some great episodes worth preserving. Like the one where Bart cheats on an IQ test, or the one in which Sideshow Bob comes back to get his revenge on Bart, or ...

— Paul Semel

The Best of the Simpsons: US\$9.98 each, \$24.98 box set. Fox Home Entertainment: +1 (310) 369 3900.

The constantly reported improvements to cyber arcades – all those blinking lights and ever more realistic virtual worlds – may provide a thrill for those of a certain age, but where's a thinking adult to find the deeper yet still awe-inspiring uses of new media? Check the art world. Artist Bill Viola's breathtaking 25-year retrospective is a high tech funhouse for adults. It's a darkened, dazzling labyrinth of 15 room-sized video installations that pulsate with large-screen projections, slowly spinning mirrors, and brief thunderous sounds.

The electrical pyrotechnics wouldn't do much without an artistic intention, and, thankfully, Viola is as much a master of his medium as he is a supreme content provider. During the course of his consistently interesting career, the Southern California-based artist has explored the juicy realm of mortality and dreams – in mind-blowing ways. Using surprising configurations of video and sound, Viola does something amazing: he penetrates the barriers between objectivity and subjectivity. In his 1988 piece *The Sleep of Reason*, for example, he evokes a bedroom in which the sights and sounds of nightmares



Dynamic high tech content for life outside the video arcade.

briefly, and violently, take over actual space.

Time is also of the essence. In a number of works, Viola captures feelings of loss, longing, and the fluidity of the moment. In the 1987 piece *Passage*, a 26-minute videotape of a child's birthday party is enlarged to wall scale in a small room and plays out over seven hours. It may sound deadly dull, but in this artist's masterful hands, the scene becomes a haunting, looming memory of a long-lost event.

It's also in the realm of time that the exhibition stretches the entertainment dollar. These durational pieces could take days to see in their entirety (though abbreviated viewing provides powerful results), and a concurrent, rather extensive program of Viola's single-channel videotapes extends the possibilities even further. But of course, quantity isn't everything. Viola offers plenty of material and presents it seamlessly, and his images are so compelling they seem to etch themselves into your mind. Just like those kids hanging out in the cyber arcade, you'll have to drag yourself away. — Glen Helfand

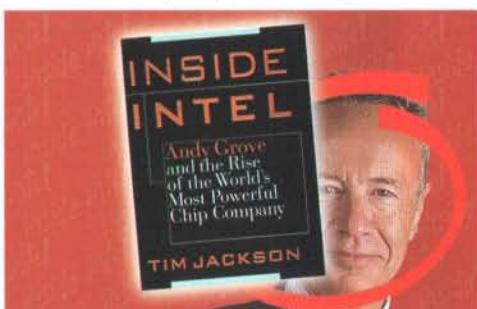
"Bill Viola": through May 10 at the Whitney Museum of American Art, New York; touring internationally. Whitney Museum: +1 (212) 570 3600.

Intel Insider

Reading *Inside Intel* after Andy Grove's *Only the Paranoid Survive* (see *Wired* 4.12, page 272) is like living through an episode of *Sliders*. Both books are ostensibly about the same world, but there are important differences.

Grove's world is one in which hard-working engineers slave away to constantly improve their product while management safeguards their greatest achievements from unscrupulous interlopers. *Inside Intel* portrays the same nerdy engineers slaving away, but the benevolent managers have turned into robber barons, ready to grind down an honest competitor or an employee.

Author Tim Jackson details how a stopgap product line – the x86 series of processors – went on to dominate the computer industry, setting the standard and imposing unnecessary limitations.



There's more to Grove's world than meets the eye.

I had assumed that Intel's success was 80 percent engineering skill and 20 percent market manipulation. I'm now inclined to revise the latter number upwards. I expected to learn the nitty-gritty of computer engineering. I've never understood what goes on inside a chip, but always thought I ought to. *Inside Intel* does a credible job explaining all that, but also details fraud, manipulative and discriminatory employment practices, plagiarism, and entrapment. That my computer has Intel inside has as much to do with these factors as with clock speeds and fab yields.

Most industry leaders have their share of dirty laundry. Jackson does an admirable job of airing Intel's in a fascinating yarn. — Jeffrey Mann

Inside Intel: Andy Grove and the Rise of the World's Most Powerful Chip Company, by Tim Jackson: US\$24.95. Dutton: +1 (212) 366 2000.

Private Survey

Worlds Away

The slow pace and still-by-still graphics of *Riven: The Sequel to Myst* may try the patience of those who like their games punctuated by gunfire. So think of *Riven* as cinema. Think of it as a book. Because although it's not for everyone, Cyan's offering blows away hyperviolent, visually repetitive games.

Riven is gamemaking at its most audacious. Visual and audio effects aside, the effort put into making the experience intellectually immersive is staggering. Because both the concept of *Riven* and its technical execution are so inspired, developers at Cyan seem to assume that you will play until you go blind. And if you hope to finish, you just might have to. The programmers have created a civilization, and then dropped you, the unwitting player, into it. You can never be sure whether a building is a temple, a control room, or a simple shelter, because everything has larger cultural significance. In one room, bronze beetles on the wall snap open to reveal Byzantine-style religious



Riven's visual grace tempts players to further explorations. scenes: a book falling from the sky; a messiah figure casting his followers into an abyss. Acclimating to *Riven* is like learning to read – you must learn to synthesize the scattered symbolism of the game into a useful visual alphabet.

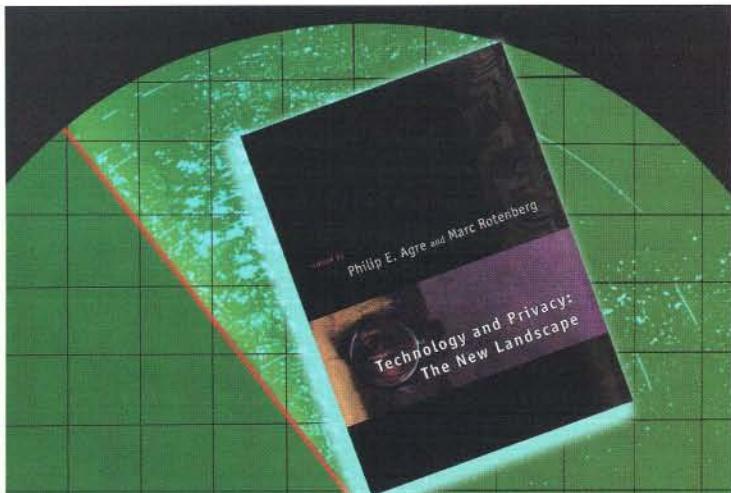
And even if you were to grow tired of the ponderous anthropology of the game, temptation is enough to win the war against your impatience. An enormous gold-domed observatory lies on the other side of a locked bronze gate, overhead walkways are just a few feet out of reach, and as you stand on one cliff top, unexplored buildings across the valley beckon through the haze. With its even pace, tireless perfectionism, and graceful flourishes, *Riven* heralds the aesthetic convergence of multimedia, cinema, and literature. It's a blockbuster and a page-turner rolled into one, but because there's no running time or page numbers, I'm still not sure how far I am from finishing. – Jacob Ward

Riven: The Sequel to Myst: US\$50. Red Orb Entertainment: +1 (415) 382 4770, on the Web at www.riven.com/.

A remarkably comprehensive and provocative collection of essays, *Technology and Privacy: The New Landscape* offers a penetrating and informative analysis of the interactions and tensions between information technology and privacy.

Edited by Philip Agre and Marc Rotenberg, this book provides a framework for developing information systems. The authors featured here are international experts in the technical, economic, and political aspects of privacy. Agre's introductory material lends considerable coherence to the book. Other essays include:

- Viktor Mayer-Schönberger discusses four generations of data protection in Europe; beginning with the early laws of the 1970s, he moves on to a greater awareness of individual rights, and then to a recognition of the right to informational self-determination, and finally to some of today's rather holistic approaches. This vital chapter shows Europe's longtime awareness of privacy risks.
- Robert Gellman muses on the viability and effectiveness of our privacy laws: "The problem is less a shortcoming of existing legal devices and more a failure of interest, incentive, and enforcement. If the will for better privacy rules develops, the law can provide a



A passel of expert opinions on private matters. way to accomplish the objectives."

• In a very provocative chapter, Simon G. Davies reflects on the public interest and observes that privacy has been transformed from a right into a commodity. He concludes that "the loss of traditional privacy activism at a macro political level has imperiled an important facet of civil rights."

• David J. Phillips's "Cryptography, Secrets, and the Structuring of Trust" deals with a topic undergoing great flux, and thus is not so current as the other chapters. Nevertheless, it presents a fresh perspective. Discussion of the Clipper chip is historically interesting.

• David H. Flaherty, who is Information and Privacy Commissioner for British Columbia, considers the extent to which surveillance can be controlled, even in surveillance-prone societies.

• Rohan Samarajiva's "Interactivity as though Privacy Mattered" concludes with this ominous warning: "Once coercive surveillance becomes routinized and taken for granted, the prospects for privacy and trust-conducive outcomes are likely to be dim."

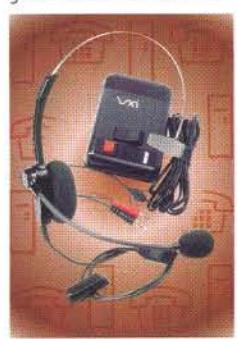
– Peter G. Neumann

Technology and Privacy: The New Landscape, edited by Philip E. Agre and Marc Rotenberg: US\$25. The MIT Press: +1 (617) 625 8569.

Power Mike

Telephone headsets are great if you have to type while you're on the phone. And computer headsets are a must if you want to use voice-recognition software with your desktop machine. And stereo headsets are great for listening to CDs ... having three headsets on your desk is a recipe for tangled cords.

VXI has two answers, both of which solve two-thirds of the headset problem. Combine the Parrot 3 headset with the company's Parrot Switch telephone amplifier, and you've got a headset that can work



Mighty headsets. with either your telephone or your computer. I use mine every day.

VXI also makes the Parrot 2 stereo headset, which works equally well for voice dictation and listening to a CD through your computer. Unfortunately, the Parrot 2 doesn't work with the Parrot Switch – that's why each headset solves only part of the problem. But if you have a computer that can do telephony, you solve all three problems. – Simson Garfinkel

Parrot 3 headset: US\$76; Parrot Switch telephone amplifier: \$116. VXI Corp.: (800) 742 8588.



Art as Science

Explosive Import

Referring to Takeshi Kitano as Japan's leading actor-director is like referring to Mount Fuji as a rather steep incline. Kitano is an entertainment phenomenon whose versatility has earned him cult status throughout Asia and Europe, though curiously none of his films have been released in the US – until now.

Fireworks (Hana-Bi) is an appropriate title for this explosive drama of an embittered ex-cop who stages a bank heist to compensate for his lack of responsibility to a crippled former colleague and his dying wife. In his belated repentance, he earns the wrath of yakuza



Kitano in the spotlight.
loan sharks and the disbelief of his former police colleagues.

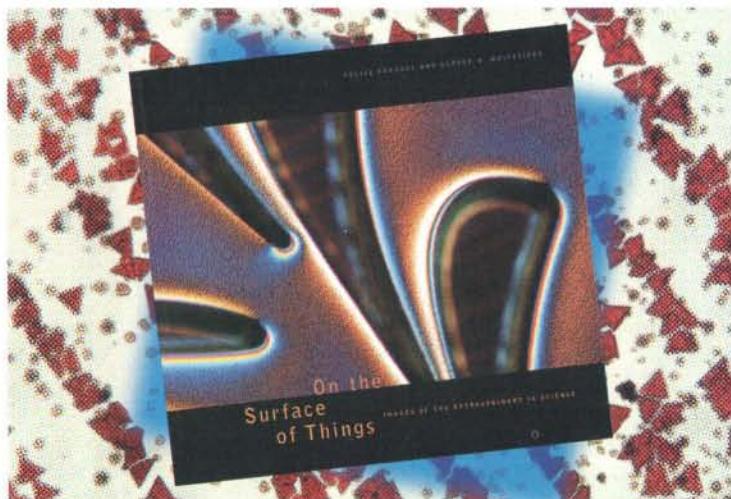
Key to the film's brilliance is the enigmatic Kitano, who wrote and directed the film while starring as Beat Takeshi. As a filmmaker, Kitano creates long, Zenlike passages pleasantly void of dialog, then savages the audience with unexpected bursts of artful violence. As an actor, he recalls the golden age of films, when stars were truly stellar creatures. – *Phil Hall*

Fireworks (Hana-Bi): opens in Los Angeles and New York in March and smaller venues by April. Milestone Film: (800) 603 1104.

If your right and left brains are constantly at war, have them make peace by delighting in *On the Surface of Things*, an art book for science nerds and gadget heads – and, simultaneously, a science book for artists and aesthetes.

This colorful volume features ravishing photographs shot by Felice Frankel, a Guggenheim fellow, artist-in-residence, and research scientist at MIT. Frankel artfully renders scientific breakthroughs – from DNA analysis to holographs – as mysterious, brightly hued images. Her work conveys the profundity of scientific inventions and observations in visual lyrics that intrigue the eye – and mind.

Her main goal as an artist-researcher is to find the aesthetic component of scientists' work to add to their documentation, without changing the science. In the visually stunning *On the Surface of Things*, Frankel communicates an emotional response to scientific discovery that cannot be fully captured in prose, by translating the depth of these findings into a language we all understand: beauty. Even those with no technical training can relate with raw enthusiasm to silicon, etched by light or microelectrodes, for example, as



Eye candy for the scientific at heart.

Frankel portrays them in images as alluring as the most gorgeous abstract canvases by painters Richard Diebenkorn or Frank Stella.

The words accompanying Frankel's photographs, by Harvard chemistry professor George M. Whitesides, are equally moving. A paragraph published alongside an absolutely stunning magnified image of otherwise unglamorous ferrofluid reads: "Pity the gryphon, the mermaid, the silkie, the chimera: creatures assembled of incompatible parts, with uncertain allegiances and troubled identities. When nature calls, which nature is it? When instinct beckons, approach or flee? A ferrofluid is a gryphon in the world of materials: part liquid, part magnet..."

Take it from me, someone who schizophrenically makes a living by both writing about and teaching college kids the virtues of art and science: *On the Surface of Things* presents one of the year's more intriguing concepts for an art book (or is it a science book?). It's a rare yin and yang concoction that satisfies both sides of the brain.

– *Reena Jana*

On the Surface of Things: Images of the Extraordinary in Science, by Felice Frankel and George M. Whitesides: US\$35. Chronicle Books: +1 (415) 537 3730, on the Web at www.chronbooks.com/.

Software Pirates

The skewed swashbuckling adventure *Shipwreckers!* is one of those pure computer games that makes no attempt to simulate reality or offer a virtual version of anything. In the tradition of desktop time-killers like *Power Pete* and the original *Castle Wolfenstein*, it simply inserts you in a series of wit-racking mazes filled with enemies, obstacles, and power-ups and asks you to find the exits.

The rules are old, but the props and scenery are new. As a rogue pirate challenging the salty Captain Blowfleet, you circumvent sea monsters and dodge the droppings of brightly colored parrots. Instead of saving the universe, you are encouraged to pillage mercilessly. The goal is to find map fragments contained in floating bottles.

The game's appeal is in its detailed cuteness. A low tech arsenal of cannonballs, roman candles,



Good ol' fashioned gaming on the high seas. powder kegs, and roaring flame-throwers and lightning bolts – my favorites – wages mayhem in each of the five environments. Some worlds are cluttered with icebergs, others are plagued with tropical storms that cloud visibility.

If your ship is set on fire, tiny howling sailors in red and white striped shirts will hop overboard until the flames are extinguished. You can recoup some of these losses by scooping them up before they drown or become shark bait. Evidently, sailors aren't too picky about where they do their swearing – you can also gain health by torching Blowfleet's boats and scooping up its crews. It's all peg legs, planks, and parrots here, a seafaring escape from the usual videogame busywork of exterminating radioactive mutants, deadly viruses, and corporate conspiracies. – *Ian Christe*

Shipwreckers! for PC or PlayStation: US\$54.99. Psygnosis: +1 (650) 287 6500, on the Web at www.psygnozis.com/.

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All Natural and Complex

Razing Arizona

It's just another day in Paradise – Paradise, Arizona, that is – and all the usual players are here: window-shoppers, children, gas-station attendants. And of course there's you, the individual known only as the postal dude – the misunderstood 3-D sprite with the trenchcoat, the perfectly calm voice, and the assault rifle.

Welcome to *Postal*, a hybrid Mac/PC CD-ROM tribute to life in 1990s America. As the inscrutable postal dude, you begin the game outside your front door, which you can't open; there's a police car in front of your house and lots of



No sense ringing twice.
men with guns in the street.
If the game rewarded introspection, you might be able to determine the psychological particulars that brought you here, but it doesn't, and your best bet is to start shooting.

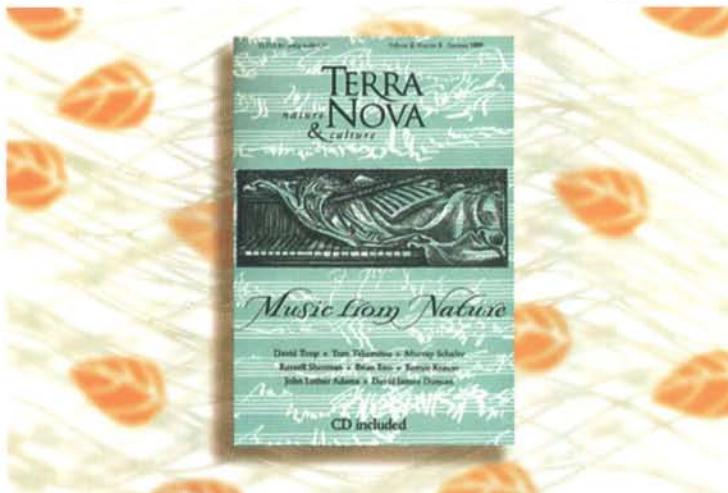
Your disturbed little postal dude utters a constant stream of witticisms amid the bloodshed. "Oh, did that hurt?" he inquires after shotgunning a cop at point-blank range. Sinister, eh? Well, consider this chilling observation: All in all, it's a pretty damned fun game. – *Chris Hudak*

Postal: US\$49.95. Ripcord Games: +1 (408) 653 1897.

Magazines focusing on the natural world are plentiful these days, but the quarterly *Terra Nova* towers above its competition. It refuses to define its mission in terms of a politically correct slant on environmental activism, or on a rhapsodic, New Age romanticism. Editor David Rothenberg and his ever-stimulating roster of writers and photographers take the position that writing clearly about nature requires a tough-minded commitment to notions of complexity and contradiction.

Issues are loosely organized around themes like *Borderline* and *Music from Nature*. Liberated, for the most part, from political or spiritual agendas, *Terra Nova*'s writers offer multiple perspectives on how nature's dark and light sides have been interpreted cross-culturally. *Borderline* looks unblinkingly at the false dualisms that often cloud ecological debates. Animal life is not treated as something purer than human, while pollution is viewed as a complicated swirl of linked pluses and minuses.

The music issue includes a CD, bringing to life essays about music's roots in natural soundscapes. Of particular note are excerpts from a book by Japanese composer Toru Takemitsu. His Zenlike appreciation



Terra Nova: fitting into nature's constraints.

of direct experience of music in nature, undiluted by academic theory, is summarized by the statement, "When sounds are possessed by ideas instead of having their own identity, music suffers." The mix of contributors puts most music magazines to shame. In what other publication can you find Beethoven and Hildegard of Bingen, Brian Eno and the BaBenzéle Pygmies?

Terra Nova delights in presenting artists who relish working in a time when virtuality and artificial life are developing, who see new technologies less as threats and more as opportunities for complex artistic engagements intertwining naturalness/artificiality. No image from the journal is more indicative of its vision than that of a piano dropped from a mountain by an avant-garde composer. Don't worry. This is purely fiction, excerpted from Thomas Wharton's novel *Ice-fields*. But Wharton offers an appropriately paradoxical, complex conclusion to this performance art: "Ivory keys are found later in the summer by hikers ... Often they are mistaken for the teeth of mammoths." – *Norman Weinstein*

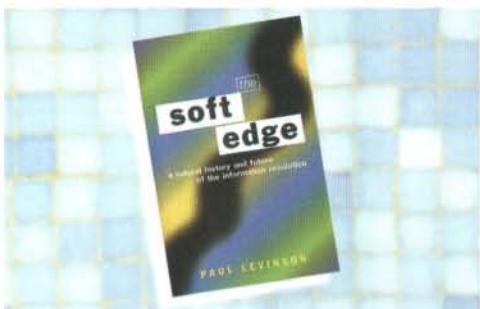
Terra Nova: US\$34 yearly. MIT Press Journals: +1 (617) 253 2889, fax +1 (617) 577 1545, email journals-orders@mit.edu.

Media Odyssey

Media evolution, like biological evolution, is no simple progression from prehistoric to futuristic, but a patchwork of fits and starts – it's mosaic. Paul Levinson takes this literally, kicking off his ode to transformative technology, *The Soft Edge*, with Moses' march down Mount Sinai.

Monotheism, it seems, failed to take hold in ancient Egypt because the dominant medium – hieroglyphics – could be mastered only by a rarefied priesthood. The Hebrew lawgiver, on the other hand, was blessed with a concise system of writing conceived to facilitate commerce. The rest, as they say, is history: the phonetic alphabet begat increasingly distributed information – and social transformation – by means of the printing press, the wordprocessor, and the Internet.

Remarkable in both scholarly sweep and rhetorical lyricism, this "natural history" spells out how remedial technologies, like the VCR, have outpaced their ancestors' limitations, gradually



The epic journey's hero – information, extending human faculties across space and time.

Yet what first promises to be the digital *Origin of Species* turns out to be a sequel to *The Odyssey*: media's progress is presented as an epic journey toward freedom, unseating censors along the way.

Ironically, *The Soft Edge* largely ignores the mischievous observation by its mentor, Marshall McLuhan, that the medium is the mass age. Levinson's archetypal "open" Web is a pull-centric, public-minded Internet. The online world, meanwhile, has morphed from global village into a city of nets fueled by competition and consolidation.

Of course, paradigm shifts have unleashed creative turbulence since at least the time of Noah. And *The Soft Edge*'s bit-driven cosmology has a deus ex machina that saves it from the information deluge – an arc of accelerating growth steered by an invisible hand. – *William O. Goggins*

The Soft Edge: A Natural History and Future of the Information Revolution, by Paul Levinson: US\$25. Routledge: +1 (212) 216 7800.

1997 Chevy Blazer turning stability claim based on GM's certified dry lateral acceleration test. 1997 Ford Explorer braking comparison based on GM's certified dry testing of 0-60 braking. Grand Cherokee fuel economy comparison based on 1997 EPA estimates of city/highway 21/27 Subaru and 16/21 Jeep Grand Cherokee. The ABC's of Safety: Air bags. Buckle up. Children in back.

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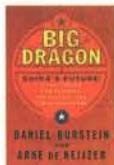
Just Outta Beta

By Jesse Freund

Mutant Faire

From the French company Ubi Soft comes a charming little game called *Tonic Trouble*. Help the kooky purple monster Ed retrieve a can of mutation-inducing agents that has accidentally fallen into the grasp of the evil Grogh the Hellish. Enhanced by the Pentium II processor, this is one of the first DVD-ROM games on the market. In all, the new title features both a clever story line and richly textured graphics.

Release: April. Ubi Soft Entertainment: +1 (415) 547 4000.



Return of the Dragon

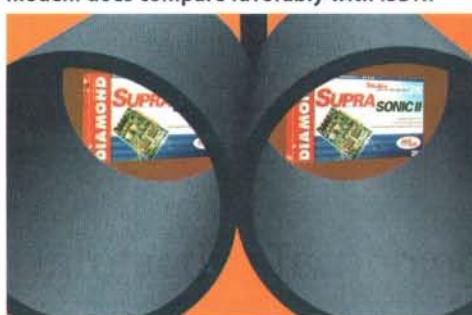
Blackstone Group senior adviser Daniel Burstein's latest book about an Asian economy, *Big Dragon*, focuses on the threat, challenge, and opportunity posed by China. Among other controversial predictions, the author believes that "in the 2030s, China will emerge as the biggest single national economy in the world."

Release: March. Simon & Schuster: +1 (212) 698 7277.

Double Barrel

The promise of widespread ISDN is finally here – although it arrives in the guise of plain old telephone service. Diamond Multimedia Systems' new Shotgun software ties together the datastreams of two analog phone lines, so these bonded 56K modems are free to realize download speeds similar to ISDN's 115 Kbps.

A bonded 56K modem won't come cheap: Diamond Multimedia's offering, the SupraSonic II, which is actually a single board holding two modems, costs around US\$200, and ISPs will certainly charge for the second phone connection. But the cost-benefit ratio of a bonded modem does compare favorably with ISDN.



Plus, Shotgun allows you to release the second phone line, so you can choose to receive calls while the data connection is live.

The bigger question: When will the 56K standards schism be resolved? Diamond Multimedia supports Rockwell's K56 flex technology, and 3Com is developing a similar product for U.S. Robotics's x2 format. Both sides have vowed to reconcile their differences this year, but it'll be difficult to convince consumers to plunk down big dollars while the smoke is still clearing. Then again, if the closest alternative is ISDN, people frustrated with spotty service will likely line up to get aboard the bonded-modem bandwagon.

Release: March. Diamond Multimedia Systems: +1 (408) 325 7000.

Schizo ISDN

For all of you with ISDN connections, Ericsson's new Home Internet Solution employs a watered-down DSL technology to transmit voice and data over the same line at the same time. When the phone rings, this modemlike terminal reduces your networking speed to 70 Kbps – down from ISDN's usual 115 Kbps – and lets you yap away to your heart's content.

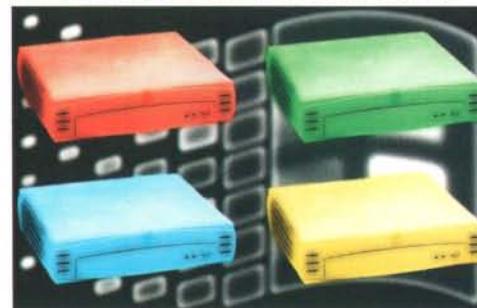
Release: March. Ericsson: +1 (972) 583 8383.



Very Dumb Terminal

What do you get when you combine Windows NT, Windows CE, and a LAN? Aside from a whole lotta Microsoft, Network Computing Devices thinks that its latest product, a thin-client codenamed Thumper, answers that question with a cheap and simple way for businesses to give many workers access to Windows applications and companywide resources.

Thumper falls under the thin-client umbrella because it reigns in local computing power – the device offers a modicum of processing power, no local storage, and the simple Windows CE operating system – but the product ties into Microsoft's new Hydra networking software, which allows people to tap applications and computational



brawn residing on shared Windows NT 4.0 servers. While some pundits have questioned Bill Gates's commitment to network computing, Hydra signals an impressive initiative – in part because it gives an entire intranet a Microsoft-controlled interface.

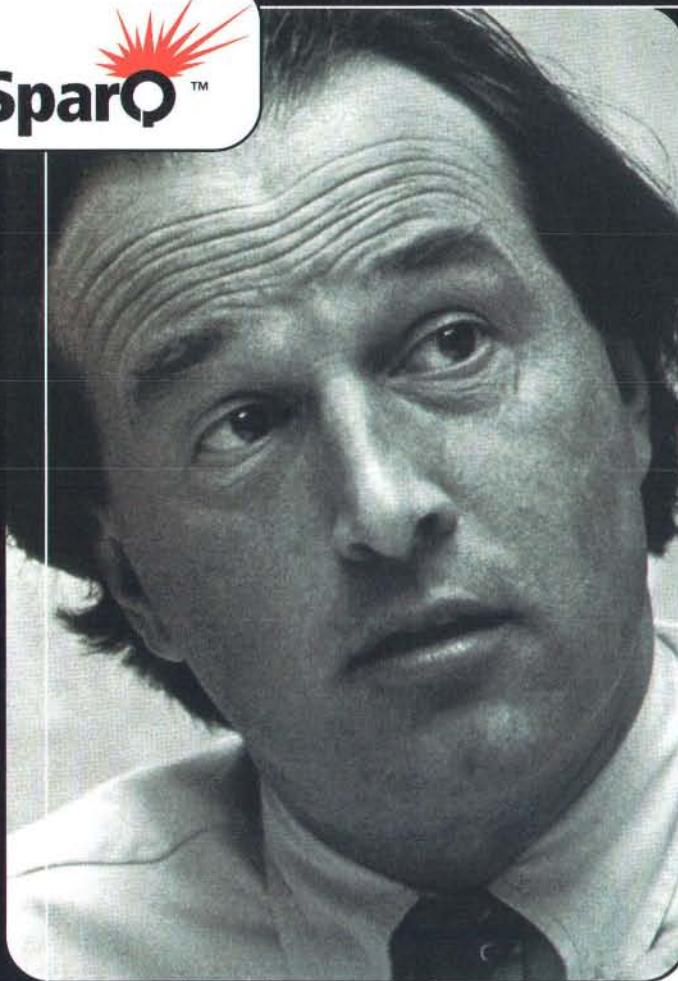
For its part, NCD is quick to emphasize the advantages of a Thumper-NT, client-server architecture: the hardware is inexpensive, people have a familiarity with Windows, and it's easy to manage applications in a centralized environment. From a business perspective, the product's main advantage over the big-iron mainframe terminals of yesteryear is a decidedly cheaper, somewhat prettier, and entirely Microsoft display for, well, the network itself.

Release: Before summer. NCD: +1 (415) 694 0650.

Monumental Misadventure

The new game *Douglas Adams Starship Titanic*, conceived by the author of *The Hitchhiker's Guide to the Galaxy*, tells the story of an interstellar liner that abruptly crashes into your living room. Board the wreckage and talk to the traumatized robots and a crazed parrot (voice talent provided by *Monty Python's* Terry Jones) to determine what caused the fatal accident.

Release: March. Simon & Schuster Interactive: +1 (212) 698 7000.



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README

ON THE BOOKSHELVES OF THE DIGERATI

Signal to Noise

The end of the decade is nearly upon us. What better time to evaluate '90s technoculture? Evidently, the moment is also ripe for taking the piss out of those who nurtured the way new zeitgeist. Author Carla Sinclair is no stranger to the scene; her latest book, *Signal to Noise*, caricatures the San Francisco slackers and scenesters, zealots and zinesters who smoked DMT with *Mondo 2000* freaks and climbed the *Wired* ladder.

Though the cybercultural parody will most amuse those who've experienced it firsthand, the unwired masses can



Tales of the city.

still enjoy this fast-paced read. Sinclair pairs Jim Knight, a stressed-out editor, with twentysomething Kat Astura. The two meet while searching for Darren Cooper among drug-using subculturites.

If you're looking for the next *Ulysses*, better go elsewhere. *Signal to Noise* trades in the immediacy of online prose. But along with its sillier trappings, Sinclair's novel offers a distinctive perspective on the foibles of the wired life.

—Tiffany Lee Brown

Signal to Noise, by Carla Sinclair: US\$22.50. Harper-SanFrancisco: on the Web at www.harpercollins.com/.

IDIT HAREL

founder and CEO of MaMa-Media (www.mamamedia.com/), and one of the first graduates of the MIT Media Lab, where she studied technology and learning. *Joystick Nation: How Videogames Ate Our Quarters, Won Our Hearts, and Rewired Our Minds*, by J. C. Herz. "Herz offers a good overview of the history of videogames and of the generation that grew up playing them. Videogames are wonderful spaces where children learn on their own, driven by their own curiosity. At MaMaMedia we want to create an educational environment that is more like a videogame than a school worksheet."



Picasso and Braque: Pioneering Cubism

by William Rubin. "This is my secret: I love coffee-table books. Most are not intellectually satisfying, but *Picasso and Braque*, published by the Museum of Modern Art in New York, is fascinating. Over a period of years, the two artists worked together, and you can see how they would take a common theme and then move in different creative directions. Together they launched a movement, a style, a community. Yet each needed his own canvas. When you think about the computer as a canvas, you realize that five children cannot share a single computer, as many educators suggest. Each child has a different creative style."

ALIZA SHERMAN

president of the media company Cybergrrl and author of *Cybergrrl: A Woman's Guide to the World Wide Web*. *The Angel of Darkness*, by Caleb Carr. "This sequel to *The Alienist* is set in New York City in the 1800s. In every era, people say how terrible things are. Reading history, I find the same problems have always existed. *The Angel of Darkness* is a murder mystery about a serial killer and a motley crew of detectives. The victims are children, and the suspected killer is a woman. The story delves into the role of women, the role of the mother. And the themes that emerge are the same ones we hear today in reaction to



Susan Smith and other criminal women. Society is still unable to believe in female serial killers. It goes against our notion of femininity."

Release 2.0: A Design for Living in the Digital Age, by Esther Dyson. "This book discusses how we as a society should integrate technology into our lives. I had thought of Dyson as a policy advocate and was expecting a dry dissertation on XYZ. But the style was conversational and filled with personality. In the chapters on community, I found a warmth that I wasn't expecting. For me, the book said that everything I've been doing with Webgrrls is viable, that community is just as important as individual privacy, that community is the cornerstone — it's the heart of the matter."

ELLEN ULLMAN

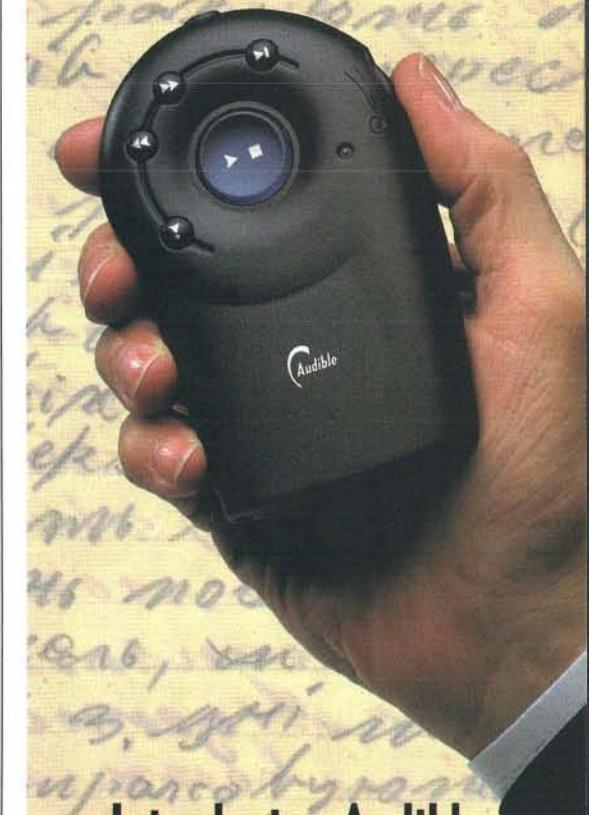
a software engineer and consultant, and author of *Close to the Machine: Technophilia and Its Discontents*. *Fermat's Last Theorem: Unlocking the Secret of an Ancient Mathematical Problem*, by Amir Aczel. "This little paperback describes the history of solving Fermat's Last Theorem. I'm reading it for a sense of how you tell a highly technical story in a way that an educated reader could understand. It follows the unraveling of a mathematical puzzle, a mystery solved over centuries by hundreds of scholars. People think of programming as a solitary endeavor, but, like mathematics, it's really a



collaboration of thinkers over years."

The Reader: A Novel, by Bernhard Schlink. "This is a gem of a novel. The writing is exquisite, the descriptions of human interaction are so vivid and so particular that they resonate. In the first part of the novel, the narrator, ill with tuberculosis, has an affair with an older woman. We see her through his eyes, again with very particular details. Then he runs into her years later. The story turns on who she has become, on her role in German history. He's horrified by the past relationship, yet still finds himself attracted to her. The leap from exquisite personal story to the sweeping historical novel is so smooth. It's a wonderful book."

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Notes from Underground

Backyard Baseball

So many sports programs are so serious. Real players, real stats, real rules. I get review copies of these things all the time, and I foist them off on local obsessive sports nerds. But I am not giving away my CD-ROM of *Backyard Baseball*.

In *Backyard Baseball*, you coach a team of dopey-looking kids. When you pick teams, definitely don't miss Pablo Sanchez. He doesn't speak English, but he's the best player in the league. I usually put him in left field. Pete Wheeler isn't too bright ("I'm gonna hit a touchdown,"



A team of misfits.

he says as he steps up to the plate), but he sure can hit. Kiesha Phillips is a must – count on her to hit it out of the park. If you pick Sidney Webber, pick her twin sister, Ashley, too – they play better together.

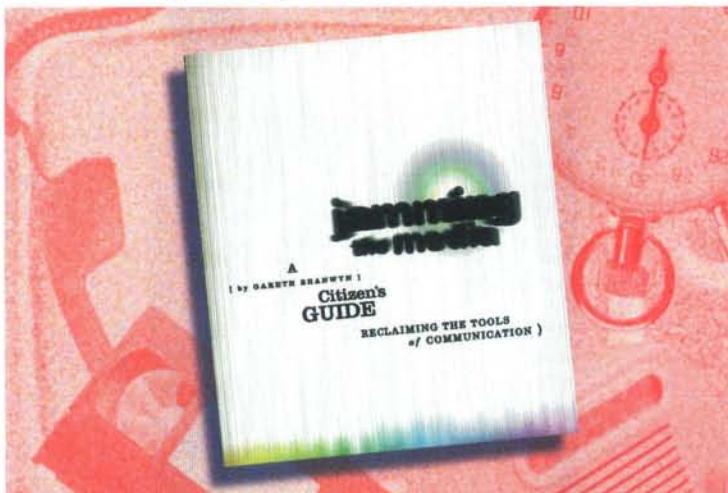
Backyard Baseball is for kids 5 to 10, but most players on my real-life team (21 and up) love it. Sports nerds may prefer more realistic ball games, but the rest of us may find ourselves addicted to leading little bands of junior misfits to victory. – Amy Bruckman

Backyard Baseball: US\$29.95. Humongous Entertainment: +1 (425) 485 9258.

Fed up with mass media that's hopelessly out of sync with your worldview? Think you can do better? Do-it-yourself publishing beckons, but where do you start? A guide of some permanence – say, a book – is called for. Yet thanks in part to the Internet, information changes so rapidly that much of it may be out of date by the time you see it in print.

Wired contributing writer Gareth Branwyn set himself a fearsome task when he sat down to write *Jamming the Media*, his "citizen's guide to reclaiming the tools of communication." Branwyn gamely resolved to compile – in print, mind you – nothing less than a permanent, accurate, and reliable resource for all producers of alternative media (zines, cable-access TV, pirate radio, music, films, video). You find yourself wanting terribly for him to succeed and – given the constraints – so he does.

With *Jamming*, Branwyn does an admirable job of marshalling the rag-tag resources of the far-flung DIY community into something resembling coherence, and a spot-check finds his sources impressively up to date. And he promises that any revisions will be posted on the Web. Yet reading the book, you're left with one of the worst symptoms



DIY publishing made accessible.

of information anxiety: is the data in front of you still current, or should you check it against what's online? The printed word never seemed so fragile.

Branwyn can be naggingly gung-ho when he pays court to his cronies at *boING boING* and his neighbors, who crop up with alarming regularity. However, his lists of alternative efforts do manage to prove there's no accounting for taste. Given the vagaries of DIY publishing, the question is not whether it's too transgressive or subversive or whatever, but whether it's any good – and Branwyn, to his credit, frequently finds fault. He apologizes for the quality of cable-access TV, buries disc-based multimedia (perhaps prematurely), and says that far too much of pirate radio is "basically devoid of content." On the topic du jour, Branwyn writes matter-of-factly – "We're losing what's really special about the Internet: people communicating with each other." A blurb on *Jamming*'s jacket declares, "There's never been a better time to have something to say." The question is, do you have something worth saying? – Ken Coupland

Jamming the Media: A Citizen's Guide – Reclaiming the Tools of Communication, by Gareth Branwyn. US\$18.95. Chronicle Books: +1 (415) 537 3730, on the Web at www.chronbooks.com/.

Contributors

Tiffany Lee Brown (magdalen@magdalen.com) writes for a veritable smorgasbord of digital and pop culture magazines from her world headquarters in Portland, Oregon. She is the editor of *Sigum* (www.slm-net.com/signum.htm) and assistant editor of the *Fringe Ware Review* (www.fringeware.com/).

Amy Bruckman (bruck@cc.gatech.edu) is an assistant professor in the College of Computing at the Georgia Institute of Technology, where she does research on educational software and virtual communities.

Ian Christie composes music for modern dance as himself, digital death metal as Dark Noerd, and *Donkey Kong*-inspired drum and bass as DJ Bazillion.

Ken Coupland (kcoupland@aol.com), a contributing editor at *Graphis* magazine, writes about art, architecture, photography, and interior and graphic design, with a focus on the digital revolution.

Simson Garfinkel (simsong@mit.edu) is *HotWired*'s technology columnist.

Phil Hall is an okapi at the Bronx Zoo.

Glen Helfand writes about art, culture, and technology for various publications, including *NewMedia*, *The Advocate*, *LA Weekly*, the *San Francisco Examiner*, and *Some Weird Sin*.

Chris Hudak (gametheory@aol.com) is a technology columnist, game critic, and judge of the Robot Wars in San Francisco. He has seen *The Color of Money* 14 times.

Reena Jana contributes to *The New York Times Magazine*, *Flash Art*, and *Asian Art News*. She needs constant visual stimulation.

Jeffrey Mann (mannj@ibm.net) lives in Amsterdam and Saint-Agnan-en-Vercors, France. He follows electronic commerce for the Meta Group.

Peter G. Neumann moderates the Risks Forum newsgroup (comp.risks) and is the author of *Computer-Related Risks*.

Jay Ogilvy is a cofounder and vice president of Global Business Network. Prior to that he spent seven years at SRI, and before that 12 years teaching philosophy, mostly at Yale.

Paul Semel (beerhound@aol.com) is the music and technology editor of *Bikini* and writes about music, books, and games for such magazines as *Ray Gun*, *Allstar*, and *Mixmag*.

Michael Stutz (stutz@dsl.org) is a writer. The text of his first novel, *Suncclipse*, has been released as freeware.

Jacob Ward is managing editor of *Axcess* magazine and lives in San Francisco.

Norman Weinstein (nweinste@micron.net) is a poet and critic who writes about the arts and technology for *The Christian Science Monitor*, MIT's *Technology Review*, and *The Boston Phoenix*.

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Spiraling

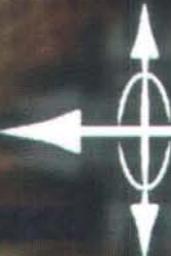
out of the void,

You open your eyes

and struggle

to understand.

A shockingly
disturbing adventure.



"Wandering
between two worlds,
one dead,
the other powerless
to be born."

THE GRANDE CHARTREUSE



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By Chris Rubin

Cordless Headphones



First Class:

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RS 8: US\$369.95. Sennheiser Electronic Corp: +1 (860) 434 9190.

Business Class:

MDR-RF940RK

With its battery- or AC-powered transmitter, this versatile 900-MHz set from Sony will work outdoors and in the home. The headphones self-adjust for a solid fit and automatically turn themselves on when you slip them over your head. They'll do practically everything but choose the music for you.

MDR-RF940RK: US\$149.99. Sony: +1 (941) 768 7669, on the Web at www.sony.com/.

Coach:

W200SX Wireless Stereo Headphone System

Recoton's 900-MHz setup comes with its own walkman-style headphones, but the unit also allows you to convert any pair from corded to cordless. Just plug in your favorite ear goggles, clip the battery pack onto your clothes, and you're no longer tethered to the home stereo.

W200SX Wireless Stereo Headphone System: US\$129.99. Recoton: +1 (407) 333 8900.

Tequila

First Class:

Paradiso Añejo

This blend of five-year-old tequilas was assembled with the help of cognac maker Alain Royer, who imported French oak barrels for added smoothness. With a complex bouquet and long finish, Paradiso narrowly beats out Herradura's US\$275-a-bottle Selección Suprema.

Paradiso Añejo: US\$95. El Tesoro de Don Felipe, imported by Robert Denton & Co: +1 (248) 299 0600.

Business Class:

Herradura Silver

Herradura is the Sara Lee of the tequila business – nobody doesn't like 'em. The distillery makes only estate-bottled, 100 percent agave tequilas, and its silver category (aged for just 40 days) delivers the pure flavor of the spiny agave plant, not of additives.

Herradura Silver: US\$23. Tequila Herradura, imported by Sazerac: +1 (504) 831 9450, on the Web at www.sazerac.com/sazerac.htm.



Coach:

Sauza Hornitos

Aged for six months in large casks, this reposado tequila doesn't have a lot of wood flavor, but it does have plenty of clean, crisp fruit. Impressively inexpensive, this is the Number One-selling premium bottle in Mexico, where distillers know their cactus juice.

Sauza Hornitos: US\$18. Tequila Sauza, imported by Domezq: +1 (203) 637 6500, on the Web at www.harsh.com/.

Laptop Bags

First Class:

Safecase Deluxe Computer Briefpack

You can spend close to a grand on a computer bag from Gucci or Bally, but nothing will protect your laptop as well – or as stylishly – as Tumi's soft leather backpack with its shock-absorbing sling. Best of all, it doesn't look like a laptop bag, so it's less likely to be stolen.

Safecase Deluxe Computer Briefpack: US\$495. Tumi: +1 (732) 271 9500.



Business Class:

Dragnet

Hipsters who wouldn't be caught dead with a traditional black-leather briefcase will relish this expandable messenger bag. Made from recycled European truck tires, all Freitag shoulder bags are colorful, unique works of art in vinyl. There's no cushioning, but they'll hold a laptop plus a sandwich or a towel for the beach.

Dragnet: US\$198. Freitag: +1 (415) 252 1460, on the Web at www.freitag.ch/.

Coach:

LapPak

If the LapPak is good enough for Steve Jobs, shouldn't it be good enough for you? Ergonomic and unquestionably cool, this padded backpack not only has great looks, but comes with a built-in wrist rest so you can pop open the flap and start working right out of the bag.

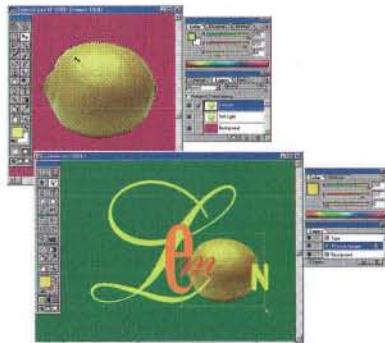
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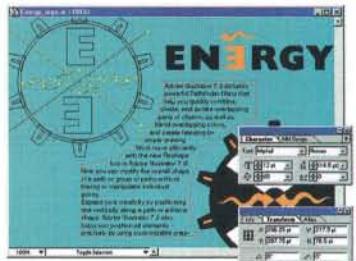
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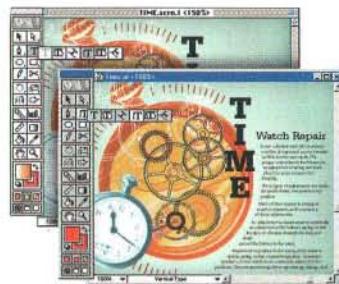
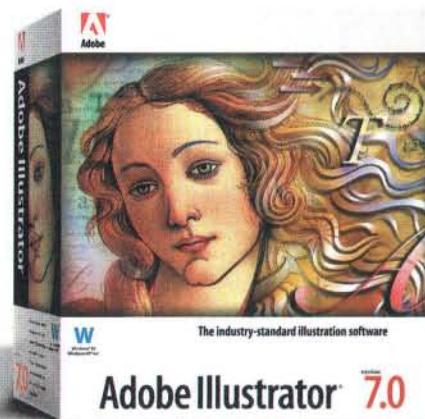
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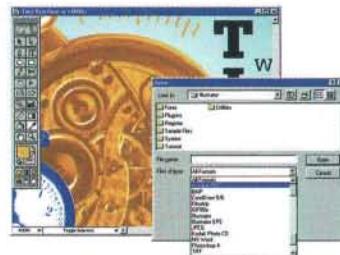
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Meetings of the minds. By Bob Parks

April 27-29

Internet & Electronic Commerce New York

Most analysts stop at predicting that Net commerce will reach US\$6 to \$8 billion by century's turn, but the GartnerGroup is actually helping us get there. Speakers at this Gartner-sponsored strategy session – among them Jim McCann of 1-800-Flowers, Michael Dell of Dell Computer, and Halsey Minor of CNET – promise to get down to brass tacks, with real-life examples of online commerce. Case studies focus on nine industries, from retail to insurance to entertainment.

Tête à Tête Potential ★★
Geek Factor ★
Idea Takeaway ★★
Star Power ★★★★

Registration: US\$1,395.
Contact: +1 (203) 256 4700, on the Web at www.iec-expo.com/.

The Current Roundup (see Wired 6.02)

March 14-17 SXSW Interactive '98; Austin, Texas.

March 22-25 PC Forum; Tucson, Arizona.

March 25-27 Ethicomp98; Rotterdam, the Netherlands.

March 25-27 Marketing on the Internet: The 1998 Conference; Phoenix.

March 29-April 2 Infocom '98; San Francisco.



April 27-May 2

Tucson III Tucson, Arizona

Also known under the title Toward a Science of Consciousness, Tucson III brings together hundreds of top thinkers from fields including philosophy, computer science, and neuroscience to discuss such questions as, "Is it possible to build consciousness into a machine?" and "Would a conscious machine exist as a souped-up PC, or as some new kind of quantum computer?" For the safety of all brains involved, this event happens only every two years. Says ring-leader Stuart Hameroff, a professor of anesthesiology and psychology at the University of Arizona, "There are more focused conferences, but nobody's been able to pull off a giant circus tent like this."

Tête à Tête Potential ★★
Geek Factor ★★★
Idea Takeaway ★★★★
Star Power ★★★★

Registration: US\$325. Contact: +1 (520) 621 7724, fax +1 (520) 621 3269, on the Web at www.consciousness.arizona.edu/.

May 4-8

CGDC '98 Long Beach, California

"There's an exposition floor and sessions, but I go just to find out what everyone's up to," says one game designer about the annual Computer Game Developers' Conference, the biggest of its kind. The show's session descriptions can be confusing, our industry insider notes, and its tutorials sometimes result in no more than a few software tweaks, but who cares? The real action is in the bars and hotels of sunny Long Beach, where thousands of show attendees engage in multiplayer facetime. Hot-tub topics this year should include the new mass-marketed 3-D acceleration cards and the Public PC/Open Arcade initiatives, bids to make the development platform for arcade games the same as for the PC. Enjoy fraternizing, but don't miss the keynote presentations from *Ultima* creator Richard Garriott and *Civilization* builder Sid Meier. Between them, these two have reinvented gaming a few times, so they can certainly help you imagine your next blockbuster title.

Tête à Tête Potential ★★★
Geek Factor ★★★
Idea Takeaway ★★★
Star Power ★★★

Registration: US\$795 through March 27, \$1,095 after. Contact: +1 (415) 905 2388, email cgdc@mfi.com, on the Web at www.cgdc.com/.

May 10-12

ACM Policy '98 Washington, DC

Call it CDA prevention. In this new annual conference, eminent geeks bring policy-makers up to speed on technology issues. EFF board member Dave Farber leads a panel on universal Net access, and UC Berkeley professor and MacArthur Fellow Pamela Samuelson runs a program on intellectual property. Other topics include Net commerce and online learning. Because this gathering also functions as the annual meeting for the sponsoring Association for Computing Machinery, many of the organization's technologists will be in town to learn how to inform public policy firsthand. Says Farber of his panel, "This one ain't gonna be quiet – people don't rally against universal access, but they do ask how the devil you fund it."

May 4-10

Africa Telecom 98 Midrand, South Africa

Because 33 of the world's 48 least-developed countries are in Africa, any new technology that's introduced there is bound to be state of the art. In other words, the continent is a prime candidate for telecom investment and high tech leapfrogging. (Why build circuits when you can send packets?) The International Telecommunication Union has organized this meeting of ambassadors, delegates, investors, and techies to discuss the new digital and wireless prospects under the theme "African Renaissance: Spectrum of Opportunity." Nelson Mandela himself invited the event to South Africa.

Tête à Tête Potential ★★★★
Geek Factor ★★★
Idea Takeaway ★★★★
Star Power ★★★★

Registration: US\$300 through April 1, \$350 after. Contact: on the Web at www.acm.org/usacm/events/policy98/.



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Generative Art

Process by which a computer creates unique works from fixed parameters defined by the artist. The result can range from an engaging screensaver to a jazz solo to a lush virtual world.

The term *generative art* is most likely derived from "generative grammar," a linguistic theory Noam Chomsky first proposed in his book *Syntactic Structures* (1965) to refer to deep-seated rules that describe any language. Steven Holtzman, author of *Digital Mosaics* (1997), traces the art form to the dawn of the information age in the 1960s, when musicians like Gottfried Michael Koenig and Iannis Xenakis pioneered computer composition. De facto generative art spokesperson Brian Eno didn't get turned on to the process until many years later.

"Generative music enjoys some of the benefits of both its ancestors (live music and recorded music)," Eno wrote in *A Year with Swollen Appendices* (1996). "Like live music it is always different. Like recorded music it is free of time-and-place limitations – you can hear it when and where you want. I really think it is possible that our grandchildren will look at us in wonder and say: 'you mean you used to listen to exactly the same thing over and over again?'"

be used," explains Buxton, who also cites the influence of ecological psychology, the study of how humans interact with their environment. "The technology is invisible and the service is delivered in the right form at the right time for the right person."

Picture a public toilet with hands-free flushing so you don't have to touch anything. Or a car phone that automatically turns down the stereo when there's an incoming call. Perhaps this subdiscipline should be rebranded technological design. ■ ■ ■

years. "People live with this romantic notion that an artist gets struck with a thunderbolt of inspiration and runs to the piano or canvas and expresses an idea. The reality is that art has a formal underpinning, and computers are a perfect tool because they're perfect for manipulating formal structure." ■ ■ ■

Meta

Modifier describing the presentation of representation. From the Greek, meaning "among," "after," or "beyond," as in *Metaphysics*, the title of the text that followed Aristotle's *Physics*.

In its strictest sense, the prefix serves as a context provider – tacked onto a field of study, *meta* designates a new discipline that critiques the original one. "Statements made in a 'meta' study are statements *about* a science or other subject area, rather than statements *within* the area," explains innovative educator Herbert Kohl in *From Archetype to Zeitgeist* (1992). Meta-language, for example, is a language used to describe another language.

A fitting meta metaphor might be nesting dolls, surrounding and embedding information with even more information. The truth, after all, is more likely to be *in* there than *out* there. Any student of the Bard can tell you that the key to grokking the drama of Shakespeare's *Hamlet* lies in the play-within-a-play. Likewise, *Mystery Science Theater 3000* relies on the self-conscious giggles that overtake us while we watch the show's hosts deconstructing the movie on *their* screen. Thus meta at least adds "novelty" if nothing exactly new. Of course, the term applies to participants, not just observers: note San Francisco's drag-queen Faux Beauty Pageant, where women dress as men dressed as women.

Ultimately, meta's meaning turns on the efficiency of inserting "brackets." Like folders within folders on your computer desktop, going meta insulates your brain from the full scope of the subject, placing it at the safe intellectual distance required for rational organization. ■ ■ ■

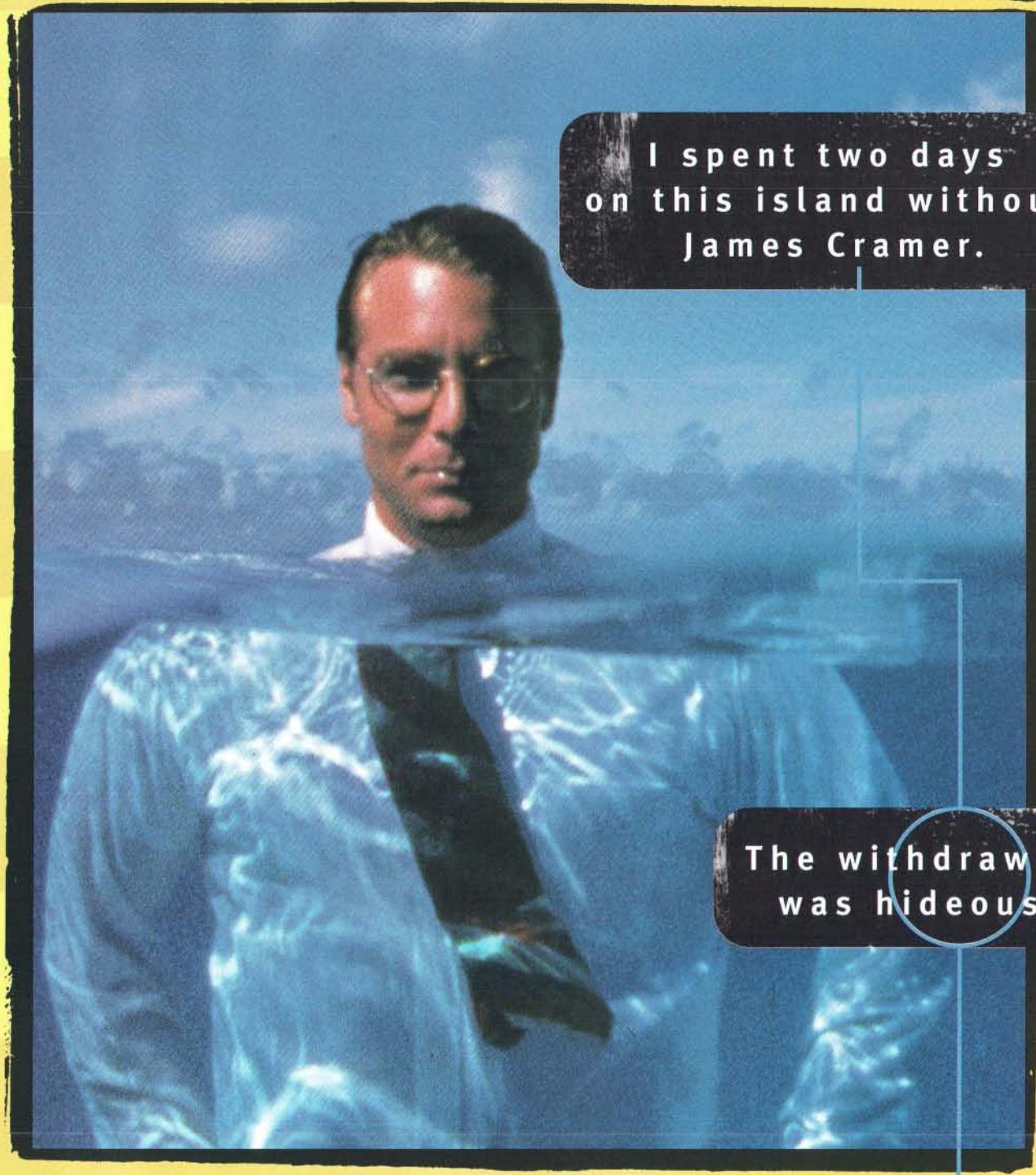
Ecological Design

Creative integration of environment and technology. While its original intent as a sustainable "green" design philosophy was to move away from the metaphor of the machine, the term is now being used to describe the incorporation of machines into our daily lives. Silicon Graphics chief scientist Bill Buxton, for instance, applies it to ubiquitous computing.

"In this case, ecological design is the design of technology that takes into account both social and physical context of where and how it will

The visual application of generative art is newer, however. In the mid-1970s British abstract painter Harold Cohen plugged in his palette and designed AARON, a computer artist that produces original work. Since then, generative techniques have been used to grow artificial life based on genetic algorithms and massively complex virtual worlds that take infinitely longer than seven days to create by hand. But whatever the output, there is always a human behind the high tech curtain.

"The computer is actually generating the art in partnership with the artist/programmer, who defines the fields of possibilities," says Holtzman, who has been experimenting with generative music for more than 20



I spent two days
on this island without
James Cramer.

The withdrawal
was hideous.

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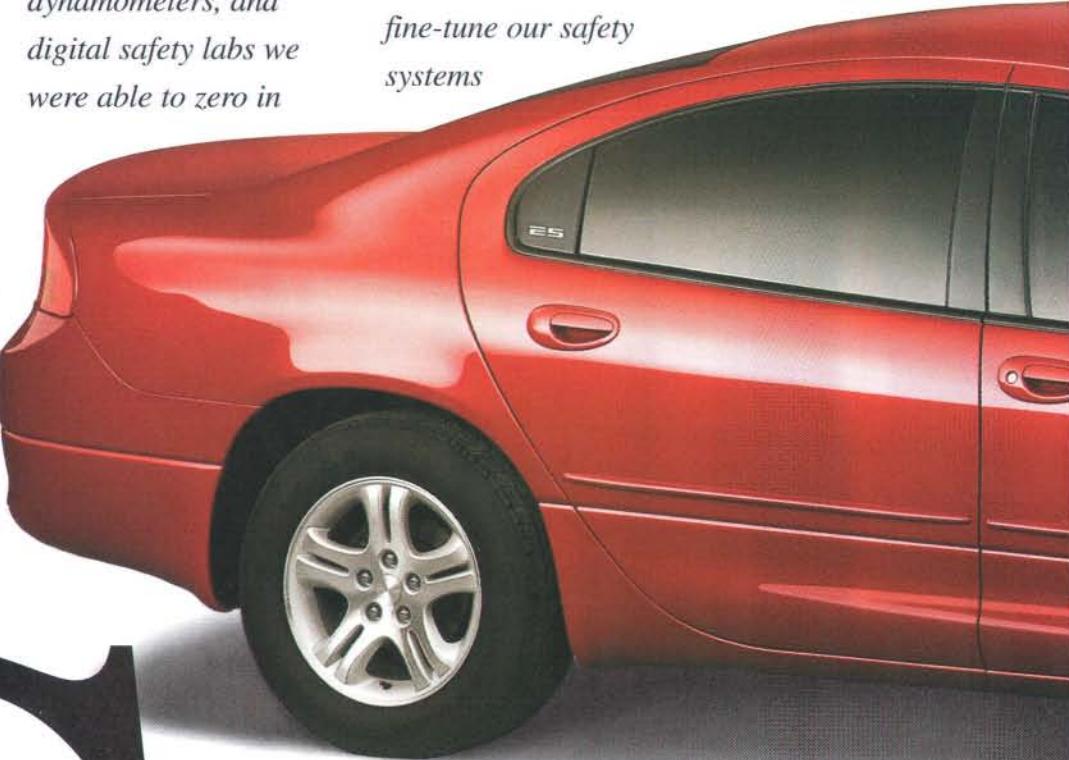


We can't say with certainty how many billions of bytes of simulated road the all-new Intrepid swallowed up before it ever saw the light of day. But we know that by testing Intrepid's systems in a virtual world of digital roads, digital engine

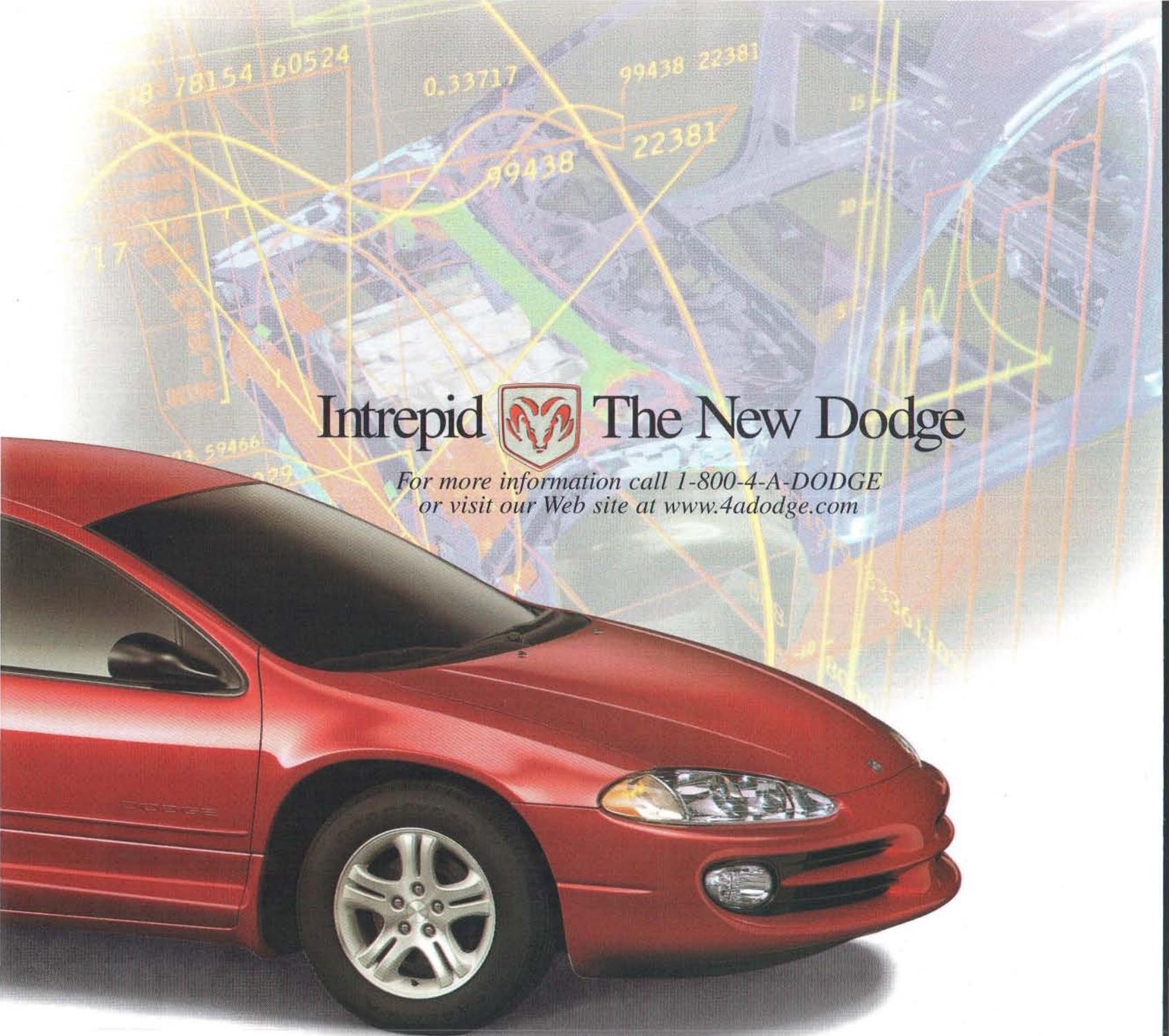
dynamometers, and digital safety labs we were able to zero in

on optimum engineering strategies early on. We were able to refine suspension parameters for an outstanding balance of handling and ride. We were able to fine-tune our base engine to pump out more power-per-liter than any other regular-fuel V-6 engine available today. And fine-tune our safety systems

to a level of confidence that is most reassuring. Of course, when the digital testing was complete and Intrepid's design was approved, we built prototypes and subjected them to a full testing program in the real world. Needless to say, we found them virtually perfect.



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ousand gigaflops
s like a charm.

Always use seat belts. Remember a backseat is the safest place for children.

CARBON

By Richard Kadrey

She knew she'd have to explain it,

probably even apologize for it, sooner or later, but Dr. Amanda Koteas didn't think she'd be doing it now. Nevertheless, after weeks of rumors and stolen memos and lab reports turning up in the tabloid press and on TV, Koteas, head of the University of Pennsylvania's Department of Molecular and Cellular Engineering and the school's Institute for Human Gene Therapy, decided to tell the full story. At a hastily pulled-together press conference last Friday, she announced to the world that not only is human cloning possible, but that she and her team had already done it — two years earlier, using an updated version of the techniques scientists at the Roslin Institute used to create the sheep Dolly, the first mammal cloned from an adult cell, in 1997.

The result of Koteas and company's bold experiment was a healthy 8-pound girl named Katy, born in secret to Virginia and Christopher Hytner at the institute on December 5, 1999.

Why did Koteas wait so long to go public with the story? During our interview, it is clear that she remains moved by the child's birth, but ambivalent about discussing the cloning. "This was a medical procedure with a name and a child's face," she says. "We were

hoping to keep the circumstances of Katy's birth out of the public eye for a few more years at least. She's a normal kid and deserves a normal childhood."

It's unlikely anything about Katy Hytner's life is going to be normal for years to come. Not only has the press descended on Pacifica, a coastal community 20 minutes south of San Francisco, but so have religious groups, film and book agents, and conspiracy buffs. While Pacifica is used to tourists, the current mix of curiosity-seekers is not sitting well with local residents. Says Thomas Winkler, owner of the Good Morning America coffee shop, "It's like there was an explosion at the idiot factory and all the debris landed here." Punching receipts into his cash register, Winkler reflects for a moment before adding, "They should all just leave that little girl alone."

The Hytners are not the only ones overwhelmed by the publicity surrounding this story. Koteas and her team are still trying to absorb the enormity of public reaction. "It's much more surreal than we ever imagined," she says. "Frightening, too."

Koteas and her colleagues have reason to be frightened. Several members of the cloning team have received death threats, while others, such as Adam Walken, whose studies into the genetics of aging encouraged the team that human cloning was possible, have been inundated with offers for movies

Richard Kadrey, the author of several novels, writes about technology and culture from San Francisco.

“If we win the Nobel Prize, I wonder

and talk show appearances. In the corridors of the University of Pennsylvania, the words “Nobel Prize” and “jail time” are mentioned with equal frequency. School president James Osterberg has issued a terse press statement: “The university in no way condones the secret and unauthorized experiments conducted by doctors Amanda Koteas, Adam Walken, Eric Mortensen, Moriah Stoltz, and Albert Gomez. A full internal investigation is under way to determine whether any laws have been violated.”

“We did the work using university facilities, so yes, technically, university funds were used for the work,” admits Koteas. “And some of those funds were tied to government grants.” The use of such funding, she acknowledges, defied the moratorium on human-cloning research encouraged by then-President Clinton in 1997. At her home in suburban Philadelphia, Koteas looks out the window. “We weren’t conducting research for the sake of research. We were applying established scientific knowledge to a specific problem. I stand by that.” She laughs anxiously. “If we win the Nobel Prize, I wonder if they’ll let me keep mine in my cell?”

All this week, while the members of the Pennsylvania cloning team pondered their collective futures, Katy Hytner, an outwardly ordinary 2-year-old who had only last week been playing with Legos and Sesame Street dolls at the Oceanview Children’s Center in Pacifica, was not yet aware of the controversy surrounding her birth.

Her “conception” began more than

two years ago in the Prenatal Diagnosis Unit at the Institute for Human Gene Therapy. The university’s cutting-edge combination of advanced computer analysis, genetic screening, and gene therapy had caused a stir in 1998, both as a scientific breakthrough and as a controversial moneymaking enterprise for the university (see “Buying the Future: Perfect Kids for Cold Cash,” *Wired* 6.06, page 450).

Combining proprietary chemical and genetic tests for diseases and congenital abnormalities, all collated by the new “expert system” software developed at Carnegie Mellon University, the institute had developed a system that, according to its own publicity materials, “virtually guarantees not only a successful

labor and delivery, but the healthy child every family dreams about.”

Virginia and Christopher Hytner had talked about having children for years. “But we wanted to wait until the time was right,” says Virginia, a part-time real estate agent. Her husband, a design engineer at Silicon Graphics in Mountain View, California, adds, “With our careers on track and our lives stable, the only things holding us back were health questions.”

The Hytners, like a lot of the boomer generation, had waited until their late 30s to have children. While both were outwardly healthy, Virginia Hytner had some concerns about the health of any child she might bear. “Even though I don’t have diabetes, my mother and an aunt do,” she explains via phone. “I wanted to know about the possibility of passing that to my child. I also know that there are other problems that a child can have when coming from a diabetic background.” Hearing of the University of Pennsylvania’s successful screening program, the Hytners took their 1998 vacation in Philadelphia.

While much of the couple’s concern centered on Virginia’s genetic background, both prospective parents went through the screening process at the Prenatal Diagnosis Unit. This procedure is fairly simple for a man; only blood tests and sperm samples are required. Potential mothers, however, are injected with the hormone-based drug Metrodin to induce “superovulation.” This bumper crop of eggs lets doctors collect samples for screening. Metrodin and related pharmaceuticals frequently bring on PMS-type cramps and other hormone-related discomforts.

Using the mother’s eggs and the father’s sperm, doctors fertilize several of the eggs in vitro. They then allow the fertilized eggs to grow until the eight-cell stage. Once the eggs have reached this phase, the doctors remove a cell from the egg and examine it using the university’s proprietary tests, as well as a standard genetic-screening procedure known as nested PCR, a polymerase chain reaction that tags and amplifies DNA sequences so that doctors – or, in this case, a computer – can look for abnormalities.

For the Hytners, the tests indicated that the cell was clear of disease and congenital defects, and the couple chose to have the already-fertilized egg implanted in Virginia’s uterus that day. Koteas, a native of San Francisco, performed that implantation herself, after

if they'll let me keep mine in my cell?"

meeting the Hytners during routine rounds at the Prenatal Diagnosis Unit. After an overnight stay and an exam the next morning, Virginia Hytnner was released to rejoin her husband and plan the arrival of their first child.

But something went wrong.

It's not hard to believe the doctors and technicians at the Prenatal Diagnosis Unit when they say they still aren't sure what happened. Modern jet aircraft, handled by expert pilots and aided by the most advanced computers, still crash. In most of those cases, human error is the culprit. Was human error responsible for implanting a defective embryo in Virginia Hytnner? We will probably never know. "There are nights I still lie awake wondering what went wrong," says Koteas. "Did a tech mislabel a cell culture? Or enter data into the new computer incorrectly? Did someone read a chart wrong? Was there something *I* did wrong?"

Virginia gave birth to a daughter on January 3, 1999. The child, which had seemed sluggish in the womb, was pronounced dead two weeks later of multiorgan failure.

The cause of death was a subtle one: neonatal lactic acidosis, a problem brought about by a defect in the mitochondria — microscopic organelles that control the metabolism of individual cells — in her mother's egg. A woman can be unaffected by the defective mitochondria in her cells, only to have them wreak havoc in her developing offspring.

The death of the Hytners' daughter devastated the couple. Even now, two years later and after the birth of a healthy child, Virginia can't completely describe how she felt: "Numb. I felt dead. After all the assurances of the doctors, I felt alone and betrayed." Koteas, who years before had lost a child to a rare chromosomal disease, trisomy 13, was also shattered by the baby's death. "We had done so well at the screening clinic, we started to believe the university's hype about us," she says. "We were perfect, and then we weren't, and a child was dead. It was awful."

Enter Adam Walken, Koteas's friend and colleague at the Institute for Human Gene Therapy. Walken was studying how cells change and break down as they age and was interested in finding a way to arrest or reverse this process. He had been studying in particular tiny sections of chromosomes known as telomeres — chemical buffers at each end of a chromosome that act like the bumpers on a car. They protect the genes inside from damage, but each time a cell divides, the telomere

buffer often decreases in length. Eventually, the telomeres become so short that they can't protect the chromosomes, and the cell stops dividing and dies.

The question Walken — and other researchers — wanted to answer was, if you could restore or stop the erosion of a cell's telomeres, could you stop or reverse the aging process? One way to find out was through studying primate cloning. Could the older, telomere-eroded cells of an adult primate be restored to their pristine condition in an embryo during the cloning process? When the Oregon Regional Primate Research Center in Beaverton cloned a rhesus monkey, Walken received a National Science Foundation grant to work and study there.

While the results of his studies on aging are still inconclusive (researchers don't yet understand all the proteins that produce telomeres, nor the mechanisms that erode the buffers), Walken did learn about the basic science of primate cloning and was a member of the team that in late 1998 first cloned a chimpanzee (an animal so similar to humans that it shares 98 percent of its DNA with us) using the technique employed by the Roslin Institute. Walken has admitted that while he was working at the primate center, he was convinced that human cloning was possible but didn't think he would ever really know in his lifetime. "The climate was all wrong. Even to say the words was a heresy," he says. "When the Hytners' daughter died, something clicked in my brain. It wasn't something planned, but the logic was inescapable."

It was during a discussion over dinner that the subject of human cloning became serious for Koteas and Walken. Both had been experiencing crises of faith in their areas of expertise and were questioning the possibilities of technical fixes to problems such as aging and childbirth. "I told Amanda about depressions we experienced at the primate center during some of the cloning trials, but said that with concentrated effort, we were confident we had worked out a straightforward and reliable process to produce identical primates for study. She told me about her despair over the Hytners. Then, all of a sudden, we just sort of looked at each other." Depending on your point of view, either a conspiracy or a bold scientific experiment was conceived that night.

Despite the almost mystical power of the word *cloning*, the process happens constantly in nature and has become routine in labs around the world. Identical twins — normal children born every day — are clones. Amoebae clone themselves when they divide. For several years cancer

GO FORTH

and retrovirus researchers have been using groups of cloned mice to test drug treatments. Plants clone themselves when they send off shoots and buds. Many common fruits and vegetables such as apples, bananas, grapes, garlic, and potatoes have become grocery-store staples because of plant breeding and cloning. Cloning large animals in a lab, however – especially mammals – is more complex.

When the Roslin Institute conceived the clone Dolly in July 1996, seven months before the sheep was presented to the world, the big question researchers had to answer was whether an adult cell that had become specialized for one part of the body (in the case of Dolly's "mother," an udder cell) could be made to "forget" that it was specialized and return to a nonspecialized, embryonic state. Dr. Ian Wilmut and his associates at Roslin made a breakthrough using a process called demethylation. Simply, they kept normal nutrients from the cell and starved it in a salt solution until it became dormant and stopped dividing. This intervention allowed the Roslin team to fuse the sleeping cell's genetic material with another sheep egg from which the DNA had already been removed – a process known as nuclear transfer.

It took the Roslin Institute 277 tries

to bring a single pregnancy to term. Still, it worked. After experimenting with rhesus monkeys for a year, the Oregon Regional Primate Research Center could achieve pregnancy every 50 attempts. When researchers there developed the chemical procedures to demethylate chimpanzee cells, they hit every 20 tries.

Once scientists have cracked the method of returning cells to their embryonic state, the rest of the cloning procedure is a relatively simple, mechanical process. After the DNA is inserted into an egg, the team gives it a microshock of electricity to fuse them together, and then another minuscule jolt – a sort of jump-start – to begin cell division. When the cells begin dividing, they are transferred to the mother's womb, just as in any ordinary fertility treatment.

In February 1999 Koteas and Walken determined that they had intact cell samples from the Hytners' dead child, and the two scientists approached the couple with the idea of, in Koteas's words, "giving them back their child – this time, the way she should have been when she was born." The Hytners were resistant at first, still in

180 ►

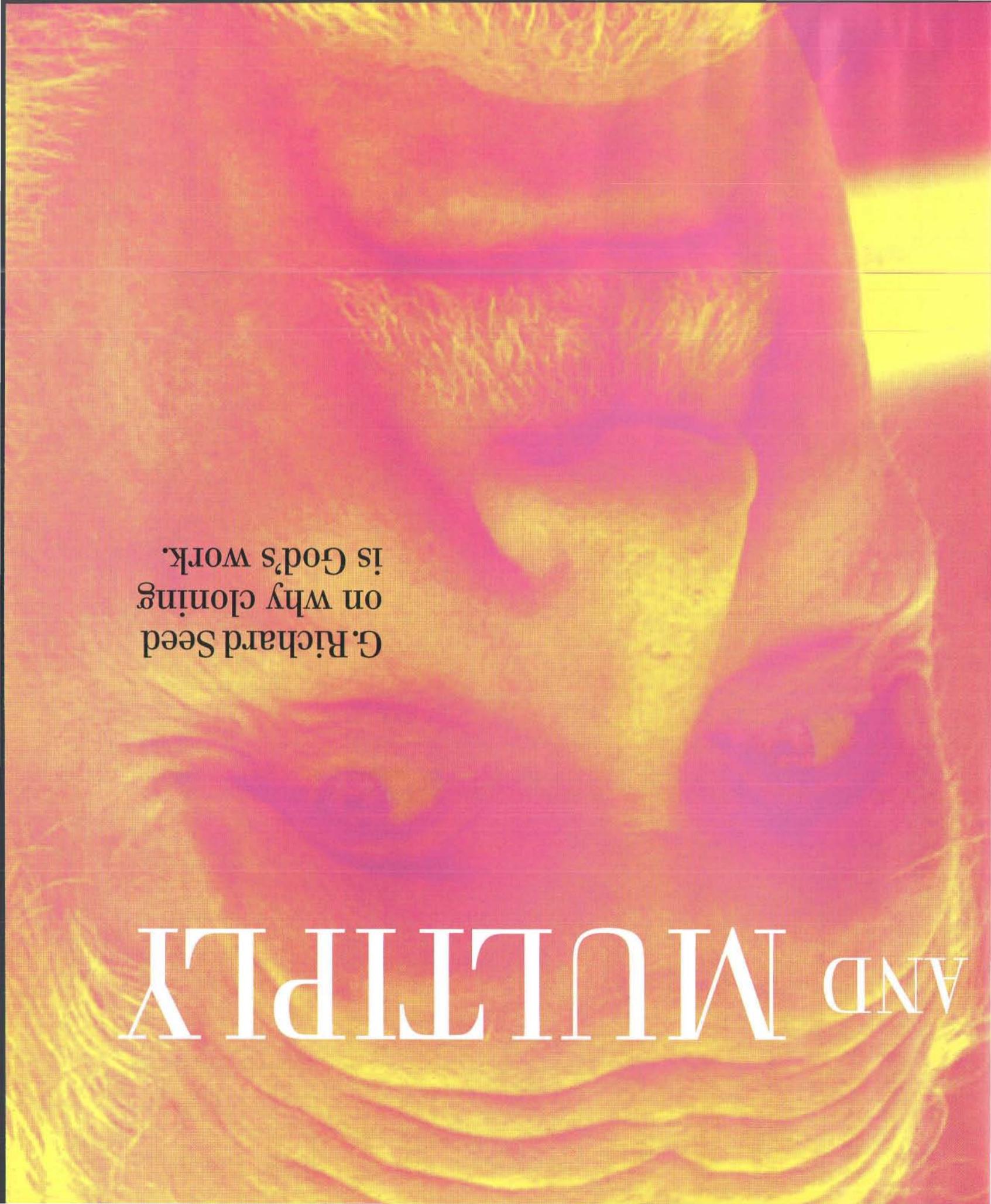
As most of the world now knows, G. Richard Seed, Harvard graduate, career physicist, and rogue scientist, aims to change the course of human evolution. He intends to clone us, and the government be damned. But pulling a complete human from his DNA top hat is only part of the trick Seed claims to be capable of. It's the peripheral knowledge – the intellectual fallout from cloning – that really revs Seed's engine: in his vision, human cloning isn't just about making spare copies of yourself, it's about providing rapid cures for a host of diseases, including cancer, and ... well, maybe you'd better hear this for yourself. Wired caught up with the peripatetic Seed at his home in Chicago.

– Richard Kadrey

"First of all, I believe in God. Second, I'm a Christian. Third, I'm a Methodist, a very serious Methodist. The Bible says that God made Man in his own image. The Bible also says that Man will become one with God. To explain this, let me digress a little: During the first few hundred years of the Christian church, there were constant arguments and debates. One of the big arguments was about the resurrection of Christ. Was the resurrection in spirit or was the resurrection in body? This was a schism of major proportions. It was settled around the third century, and the resolution was that Christ was resurrected in both spirit and body. This is still the doctrine in Christian churches all over the world. The same interesting question is present now. When God intends to meet Man with himself, is that in spirit or in body? I choose the interpretation that it includes spirit and body both. Human cloning is one small step in that direction.

You can now seriously contemplate unlimited life extension and unlimited access to knowledge. The Scottish cloning experiments proved that you can reprogram the DNA in cells back to division zero – back to undifferentiated cells. If we can learn to reprogram DNA back from division 30 to division 15, that would be great. You're going to be 20 years old again! And we could repeat that as many times as you'd want. It's mind boggling.

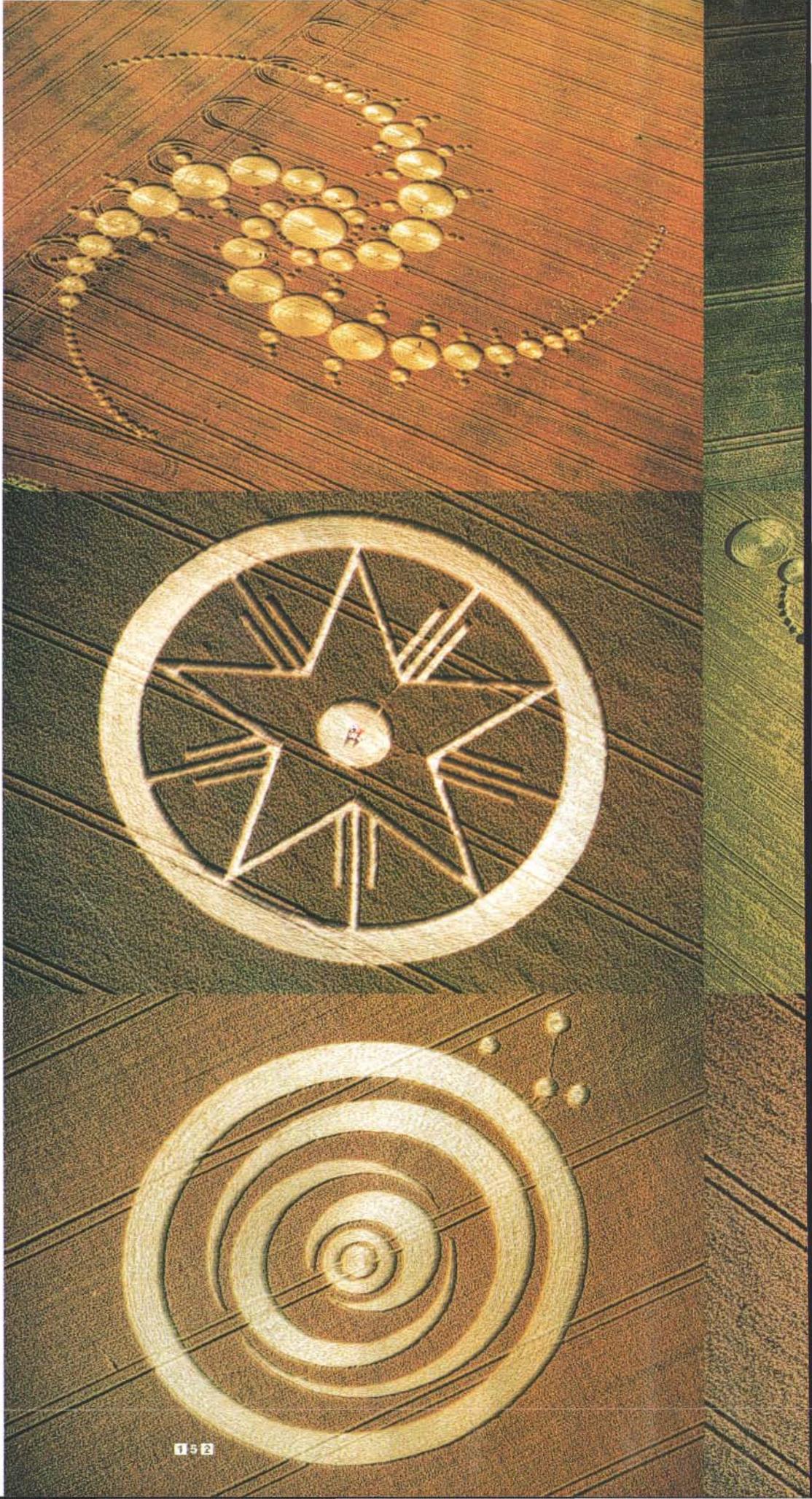
But I'm really interested in more immediate applications. What if we took a cancerous cell of the same type used in Scotland – a mammary-gland epithelial 182 ►

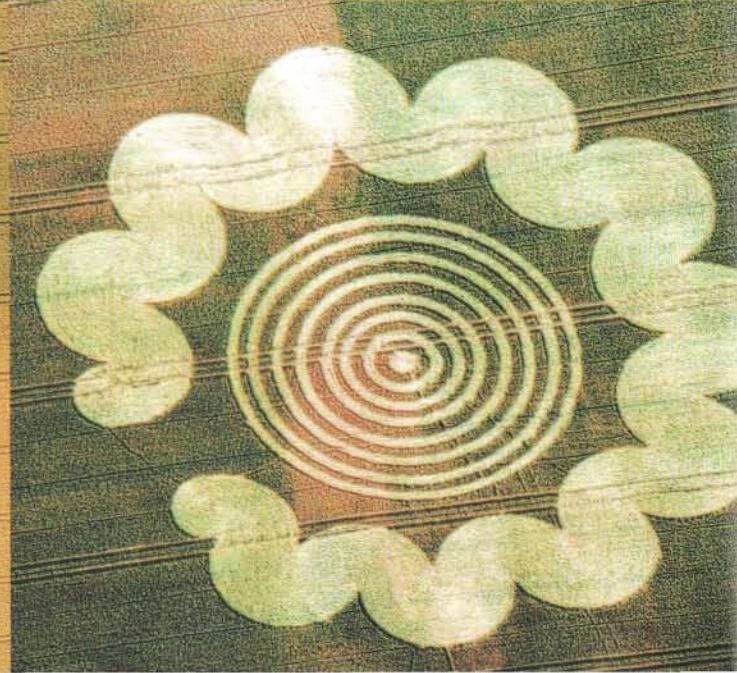
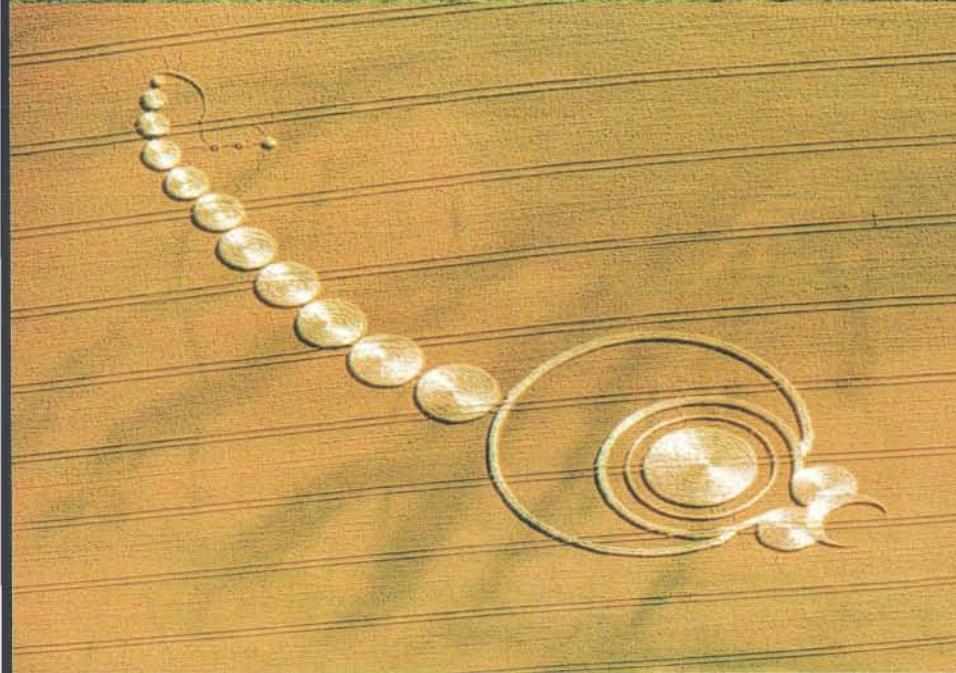
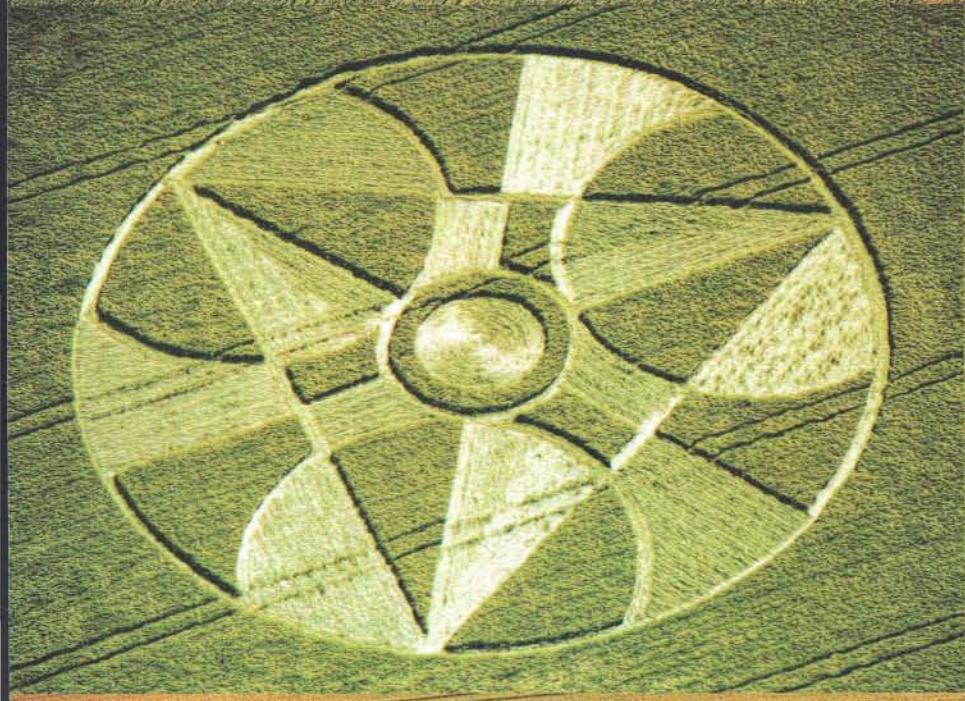
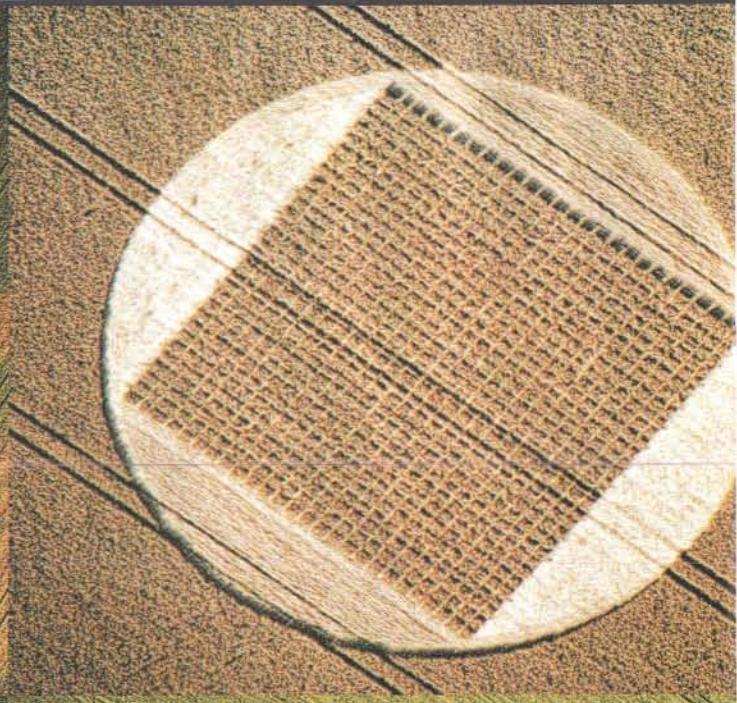


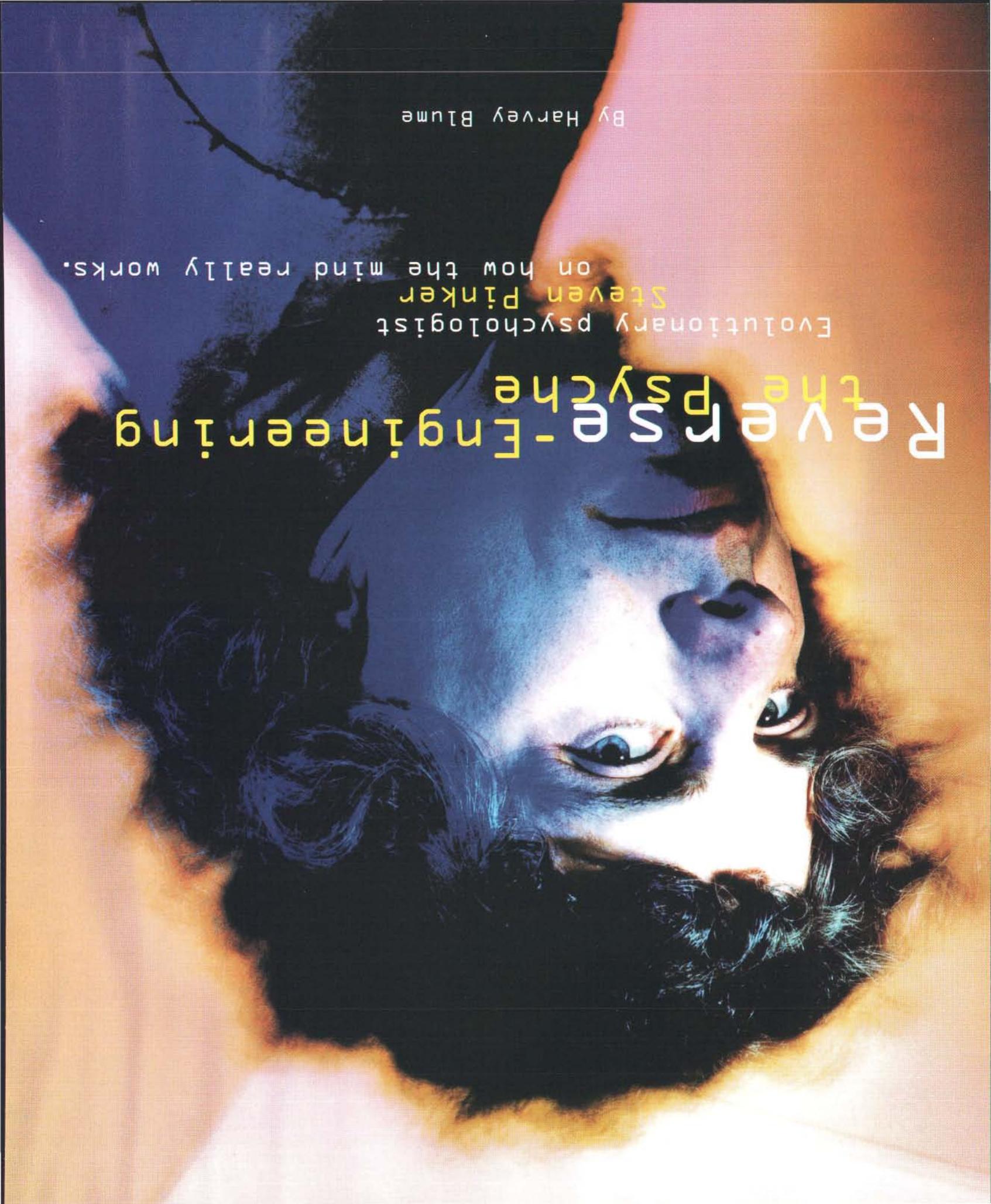
AND MULTIPLY
G. Richard Seed
on why cloning
is God's work.

Crop Circles

Steve Alexander began photographing crop circles after he witnessed a ball of light over a field in Wiltshire, England. These nine shots date from 1994 through 1997 and are available, for a price, at alpha.mic.dundee.ac.uk/ft/crop_circles/XCERTS/steve.html. Indeed, for every attempt to explain these mysterious patterns' origins — plasma vortex, military experiment, alien spaceship landing — there are a thousand "experts" ready to sell you their theory. Curiously, no one has yet spotted a formation resembling the dollar sign. — Tom Claburn







By Harvey Blume

on how the mind really works.

Steven Pinker

Evolutionary psychologist

REVIEW Psyche-Engineering

Wired: How has computer science contributed to the field of evolutionary psychology?

Pinker: Traditional evolutionary explanations of the mind have been very crude, relying on things like “territorial imperative” and “sex drive.” Given the complexity and richness of human thought, that’s not a satisfactory answer. But if what evolved is a complex set of information processing mechanisms – neural circuitry designed for intricate computation – then you can have both the richness of human thought and a scientific framework to make sense of it.

So the brain is a naturally evolved neural computer.

Who shares that view?

Virtually everyone in cognitive science, from Marvin Minsky to Noam Chomsky. It’s actually easier to point to the people who think the brain is not a neural computer – they are flamboyant, though few in number and unrepresentative.

It’s hard to ignore that our brains are made of information processors. Down to a neuron’s axon and molecules, the nerve cell is designed to be an information carrier. Too often we think of neurons as bean counters, but they’re much more like sophisticated chips or microcomputers. And if neurons are like chips, when you wire up a hundred billion of them you get a very powerful computational device. That’s the only explanation for how a hunk of matter can do intelligent things – unless you think there’s a special kind of substance necessary for intelligence, which would mean robots and artificial intelligence cannot be created.

Does this mean that to build smart machines we should study the evolution of the human brain?

The answer is an emphatic yes. Nature has been doing R&D much longer than humans, and engineers often learn from the natural world. For example, composite materials like fiberglass or carbon fiber, which embed filaments in a matrix, are based on the design of wood. Genetic algorithms are obviously based on natural selection. And stereophotography, used in aerial reconnaissance, is based on stereovision in animals.

Whether working with neurons or transistors, is there only one way to make a developed brain?

That is the question of artificial intelligence. Some scientists suggest there may be only one way to build an intelligent device, and, therefore, if we build one ourselves we will automatically learn about the human mind. My sentiment is that in general there’s more than one way to skin a cat – there are almost always multiple algorithms. In biological evolution, you often find different solutions to a given problem – compound eyes in arthropods versus camera-like vertebrate eyes, internal versus external skeletons, and so on.

Not everything about the brain is perfect. Mental “noise” often clouds our memory of details and facts. What function does this serve?

Noise – because it is noise, because it’s not systematic – is hard to pinpoint. Our faulty memory, for example, might be noise, or it might be the result of a trade-off. If the brain was a perfectly accurate information processor, our heads could be too big to carry around on our necks. Or we might starve to death because the brain would eat up two-thirds of our daily caloric intake. Also, if we remembered absolutely everything, it could be like one of those Internet searches where you type in a keyword and get 6,000 matches. What we think of as bugs in memory might instead be features; maybe the most relevant, most useful piece of information is simply what pops into our mind first.

Won’t people object to the idea that our minds are neural networks, nothing more or less than complex computational devices?

There is resistance. A number of moral notions, such as free will, hinge on our not being just data-processing machines.

How does evolutionary psychology define free will?

Free will is not a scientific concept: it means “not caused by anything,” and the scientific worldview can only seek causes. It is a moral concept – an idealization of human beings for the purpose of moral reasoning that designates certain kinds of behavior as those for which people ought to be held responsible. Which kinds? Roughly, those that involve the higher decisionmaking circuits of the frontal lobe of the cerebral cortex, which can be influenced by knowledge of the consequences of certain types of behavior and other people’s opinions of those behaviors.

We have to go on trying to apply scientific reasoning to human behavior. But we also have to remember that ethical reasoning is in a separate sphere that cannot and should not be confused with science.

Is this what you mean when you write in *How the Mind Works* that certain kinds of problems are hard for us to resolve “because the mind of Homo sapiens lacks the cognitive equipment to solve them”?

Right. It has to do with a limitation of our abilities to conceptualize. Maybe Martians could explain things like free will to us. But if they did, we might not understand the explanation. ■ ■ ■

Steven Pinker’s best-selling book, *The Language Instinct* (1994), provided a lucid description of the human brain’s amazing linguistic capabilities and showed how language arose in the course of evolution. In his controversial *How the Mind Works* (1997), Pinker stalks even bigger game: the mind itself.

Pinker argues that we should “reverse-engineer” the brain – figuring out what natural selection designed it to do in the environment in which we evolved. Along the way, he breathes new life into old theories – that the mind is a machine, that human nature is shaped by natural selection. He also debunks conventional thinking – that parents socialize their young, that we acquire reading, math, and higher skills instinctually. His findings, both big and small, have broad-reaching implications for how we live our lives. *Wired* caught up with Pinker at MIT, where he is a professor and director of the Center for Cognitive Neuroscience.

Harvey Blume (joel@ai.mit.edu) often writes on culture and new media. He lives in Cambridge, Massachusetts.

Doom Out of Ləəiōn

By David McGandless

John Carmack and John Romero.

Now they are recruits in the real-world deathmatch between *Doom* creators

Doom's diehard fans helped make it the most popular PC game of all time.

By hacking its engine and designing new levels,

G

un-and-knife show! Something for all the family!" screams a billboard as Sverre Kvernmo cuts through downtown Dallas in his dented BMW.

It's 103 degrees on a hot, thick day. Kvernmo cruises past a rotating restaurant shaped like a huge golf ball, peppered with lights and perched on a stick 580 feet high. In the distance a flag-decked castle and a replica of an Indian fortress peek through the haze. Crazy place, Dallas.

The LBJ Freeway slices between skyscrapers built by big oil and, more recently, Ross Perot. The Texas Commerce Tower, the second-tallest structure in town, is famous for having a hole in the middle – on purpose. The building's penthouse is even better known in other circles because of its resident – John Romero, owner of Ion Storm and cocreator of *Doom* and *Quake*. Six blocks down, on a touristy promenade just a gunshot away from a certain notorious book depository, resides Ritual Entertainment, maker of a *Quake*-powered game called *Sin*. Nearby Garland, Texas, is home to Apogee Software, creator of *Duke Nukem 3D*. A couple of miles south, in Mesquite, lies id Software, where Romero's erstwhile partner John Carmack continues to tap the profits of *Doom*. "That," Kvernmo says, "is where it all started." A grimy Holiday Inn sails by.

It's all here in this 30-mile stretch of asphalt that links Dallas's latest booming industry: the 10-gallon paychecks, the double deals, the internecine digital warfare. Indeed, the high-stakes gamesmanship is what makes Sverre Kvernmo call this gun-and-knife city home. He is a "Doom Baby," raw gamemaking talent spawned by *Doom*'s release four years ago.

In the early '90s, Kvernmo was cleaning hospital hallways in Norway. Now he builds virtual environments for shoot-'em-ups. In a world gone 3-D crazy, he has become one of the industry's most valuable commodities.

"I'm being paid to do exactly what I want!" the 26-year-old shouts. "I can't believe I'm here. I'm from a town north of the polar circle in Norway – *really* exciting," he scoffs. "I would probably be killing whales or something if it weren't for the

Internet and
Doom."



In 1993 *Doom* arose from Dallas and went supernova, at once Game as Million-Dollar Revenue Machine and Game as Open System. Its code was semi-intentionally left ajar on release. A couple of signposts, a few backdoors, and some secret passages into its structure – enough to inspire a fevered community of hackers to dissect,

reverse-engineer, and completely redesign the game thousands of times over.

Hacking *Doom* swiftly became a massive underground industry – gigabytes of add-ons, graphics, and levels were passed around the planet. By letting code and schematics filter into the public domain, id effectively licensed its game to the world.

Kvernmo, in the meantime, became a lord in *Doom*'s amateur fiefdom. For if manipulating the engine was an art, level design – a combination of hard coding and high design – was its purest form. Sure, the engine powers the game and handles the placement of every entity – the chain guns, the moaning zombies, the blood-soaked walls. It defines the physics, creates the sound, and makes sure everything is combined in a seamless world. But here's a dirty little secret: an engine by itself is just a piece of mechanics. The game experience comes down to the enclosed environments where you do your fighting, exploring, and dying. The levels.

Of the hundreds of would-be level lords, only a handful showed true promise. Thanks to the Net, experts like Kvernmo swiftly became celebrities in their own crazy corner of game land. Adopting comic-book names like Dr Sleep, Paradox, and Cranium to increase their mystique, they spent days turned months turned years obsessively honing their skills.

Doom spawned these skilled fanatics, but it was id's next game, *Quake*, that reared them into professional talent. For while they ferreted away on the amateur scene, the fabled egos at id, John Romero and John Carmack, had split. Eccentric designer and game lover Romero left to form Ion Storm and begin work on one of its first products, the time-travel epic *Daikatana*. King coder and tech lover Carmack remained to pursue ever more revolutionary programming feats, all to be expressed in id's *Quake II*.

Meanwhile, other companies set about licensing the *Quake* engine as a platform for their own games. Almost overnight, demand for skilled designers triggered a feeding frenzy. id was



there offering jobs to the very talent it had created. So was Ion Storm. So were the checkbooks of publishers like Activision, Sierra On-Line, and Eidos Interactive. And in the middle of it all, the Doom Babies.

When *Doom* was released in 1993, its code was left semi-intentionally ajar – far enough to inspire hackers to dissect, reverse-engineer, and completely redesign the game thousands of time over.

Two years ago, Kvernmo left his native Norway to study art in Bristol, England. He barely made it to lectures, though, because he was addicted to *Doom*. Not just playing the game – changing it, building ever more convoluted killing arenas. "For three months solid I worked late into the night, fell asleep, woke up early, and started all over again."

David McCandless (dmacca@cix.co.uk) is a London-based freelance writer and musician.

His levels, meanwhile, traveled at warp speed through the wires, siphoned off to every corner of the globe. Kvernmo was soon spotted and snapped up by LA-based game developer Xatrix Entertainment. Despite the remonstrations of his parents, he flew out and joined the design team for a *Doom*-meets-*Deliverance* title, *Redneck Rampage*.

Six months later, John Romero called. "He really wanted me to be a part of his new project," Kvernmo says, "and it was Romero, phoning me. I, we – all of us – loved Romero."

Beyond the allure of the fat paycheck, "creativity and design were the focus of Ion Storm, so it seemed like the perfect place to work," Kvernmo says. "I had to go." He completed the final leg of his pilgrimage in March 1997, arriving in Dallas to find that his contemporaries had already made the journey.

Ion Storm is not just the domain of twentynothings, however.

John W. Anderson (aka Dr Sleep) works in a booth alongside Kvernmo. Forty-one and graying, he brought his



Daikatana (left to right): a satyr guards a temple on the Isle of Crete; inside a regal grand hall in the palace on Knossos; the futuristic Benetron Research Center, where the cure for AIDS is discovered in 2030.

baby grand piano from Pennsylvania so he could play Schumann when not building classical Greek-inspired *Daikatana* maps.

Like Kvernmo's mania, Anderson's obsession with *Doom* changed his life. The fixation first drew him out of the Pennsylvania Department of Public Welfare to the Action Games Forum on CompuServe, which, in 1994, had become a mecca for *Doom* heads and architectural aspirants. At its height, anyone who was anyone in the community hung out there.

Within weeks of *Doom*'s shareware release in December 1993, map editors appeared, allowing items to be repositioned, floors to be raised or lowered. Yet the first levels were mere reworkings of the existing maps – nobody had sufficiently reverse-engineered the technology to start new levels from scratch.

The breakthrough came three months later, when a group of students working at England's University of Bradford combined the efforts of hackers worldwide and cracked the final layer of *Doom*'s map format. They recompiled the BSP tree – a mathematical representation of a 3-D level – which allowed them to reconstruct the geometry of the maps. And that was it. Building on the existing work of amateur hacker Brendon Wyber, Belgian student Raphaël Quinet built a level editor called DEU around an algorithm and uploaded it March 30, 1994. Literally overnight, the first all-new levels arrived and the community was in place. Levels swamped FTP sites and CompuServe file libraries.

These new worlds, though, were only outposts in the universe created by John Romero. He is the first 3-D level designer, the Yoda of the *Doom* babies. Romero's opus, "Knee Deep in the



Dead," was the first eight-level episode of *Doom* – regarded as the seminal work, it's still played by tens of millions of people worldwide. His artistry, eccentricity, obsession with a good deathmatch, and pop-star looks made Romero the public face of *Doom*, the frontman for thousands of adoring nerds.

"For us," says Anderson, "Romero was id."

"I really wanted to be with Romero," Kvernmo confesses.

Sitting in a small booth opposite Kvernmo, Romero is playing a "milkmatch" – a deathmatch with a twist. "Whoever loses the best of two out of three has to drink rotten milk out of a jug that's been sitting there for months," Romero explains, laughing maniacally. His eyes are rooted to the screen. "You pour it into a big cup. It comes out in like yellow blocks."

Romero clearly loves what he does and goes at it with a shrewd yet childlike



intensity. "Kvernmo's so cool," he says, wide-eyed. "And we've got Dr Sleep. He's cool, too." It's not boasting or a marketing ploy. Romero is genuinely excited by the talent that surrounds him. But then, he played hard to get it.

"He said: 'Pack your stuff and come down,'" recalls Anderson. "'What, next week?' I asked. 'No,' he said. 'Put your stuff in a car and come down now.'" Two days later, Dr Sleep settled into one of Romero's many spare rooms.

Like deathmatching, game design is a bloodthirsty business. It's an industry that has already jumped into Hollywood's billion-dollar bracket. Now, with more than a jug of rotten milk at stake, Romero is playing a bigger match – against his former colleagues at id, and against the many companies that have licensed the *Quake* engine as the backbone of new games.

"Why bother paying the best guys in the universe to build you a brand-new game engine when you can hire one?" says Romero. "Everyone can have John Carmack working for them."

Well, not everyone. If you're making less than US\$5,000 a month from *Quake*, you have nothing to fear. However, id claims 12.5 percent of your net income over that amount. And if you license the *Quake* engine for your own title, it comes with a hefty price tag, currently around \$500,000. The flat fee is negotiable, depending on royalty agreements, but either way, a percentage of every *Quake* engine game sold goes to id.

id had additional incentive to tighten the financial reins. "A shitty cottage industry sprang up out of *Doom*," explains Kvernmo. "Loads of people were doing crap maps or collecting them off the Internet and then sticking them on a CD and selling them for like 40 bucks each."

Poor-quality maps meant bad PR for *Doom*. Ironically, the profusion of crappy levels created huge demand for



"I really wanted to be with Romero",
confesses the Norwegian-born
Sverre Kvernmo.
"All of us loved
Romero.",

All the top Doom Babes
were courted by id,
but only Tim Willits
took the job. "I spent
months working with
Romero — picked his
brain," explaining
Willits' departure.
Romero's departure,
Willits says, "He's a
great guy, but a shitty
manager."



By Kevin Kelly

And other heresies,
as pronounced
by Peter Drucker.

Wealth
Is
Overrated

Wired: My father's life, when he was my age, was not much different from mine in its daily routine. Is change slowing down?

Drucker: I've been telling people for 30 years that material changes in our lives are almost irrelevant. The important changes are demographic, in health care and education. The demographic revolution of the last 40 years is unprecedented. Today, the majority of people around the world live in cities. Urbanization changes your worldview. So, the real change is in meaning, not in goods.

What can we expect to happen because of these changes?

Thirty years from now, the big cities may be dying very fast. Downtown office buildings have become dysfunctional. As information and ideas have become mobile, the kind of work that doesn't require contact with customers or contact with other professionals - in other words, 75 percent of the work in any organization - doesn't have to be done downtown. For 300-odd years we have had a continuing, occasionally interrupted real estate boom. It was slowed down by depression, but not stopped. That boom may be over for good.

Asia is disagreeing with you. They are building super high-rises.

Malaysia, for instance, is committed to building the world's most disagreeable city. They're building megalomaniac skyscrapers, the biggest mosque, and the biggest traffic jams. It isn't just the old cities that have become nightmares. The new ones are just as bad.

Do you agree that the influence of government is withering?

Government is a growth industry. With all the talk about cutting government, the governmental share of the total gross national product has actually grown steadily in the last 20 years. It's now about a third or more all over the world. Business - the production of goods and services for consumption - as a share of the gross national product has been going downhill steadily since 1900. All of business, including farming, is shrinking at the rate of perhaps 1 percent a year, compounded.

So business is waning and government is rising!

Look, France under Louis XIV or XV had probably 4,000 central government employees in total. When people talk of Versailles, they think it was an enormous, luxurious castle. Actually, it was a small, squalid office building. The royal quarters were no larger than my house. I have a big house, 2,500 square feet, because both my wife and I work at home. But the king of France didn't have much more. The rest of Versailles was unbelievably squalid office space in which the families of the government employees lived in corners of rooms, without indoor toilets. You couldn't even fit a small bureaucracy in Versailles.

Since 1900 the growth areas have been government, education, and health care. Government, which has been growing, may stop growing. We may be at the crest.

Do you believe there's a growing gap between the rich and the poor in America?

The way you phrase it, the answer is no. The gap is quite different. There is a growing gap between people with advanced education and people without. The difference in income for an

Afro-American with a college degree is statistically insignificant (if you adjust for age and length of service) from the income of a white, Latino, or Asian with a college degree. Up to about 1970 it was economically nonrational to go to college - in other words, you did better economically by not going to college and instead getting a unionized job in the mass-production industry. But those kinds of jobs are disappearing. And since those jobs were relatively disproportionately filled by blacks, it hurts the black community most. So the gap is almost 100 percent educational.

Is capitalism changing?

At the height of his fortune, J. P. Morgan was probably worth one-third of what Bill Gates is worth now, adjusted for inflation. Out of his own pocket, J. P. Morgan could finance all of America's economic needs (except residential housing) for four months. Bill Gates's US\$36 billion would let him finance America for maybe two days. The rich no longer matter. They're celebrities, not capitalists anymore. The real capitalists are the middle-class people who put \$25,000 into a mutual fund - that's many trillions of dollars.

Do you favor antitrust action against Microsoft?

The main mission of American antitrust efforts has always been to bring a suit when the monopoly is just about over. Historical leaders like Microsoft are very vulnerable to missing a strategic turn. If you're that far out and that dominant, you have no friends. You're exposed. But when you get in trouble, you need friends. Microsoft is in an exposed position, and it takes just one major mistake, one major messing up of a major turning point, and then nobody will lift a finger to help them.

Is Microsoft going to be the next IBM?

The probability is yes. Actually, there is an outsize probability that Microsoft may be tomorrow's Control Data, which essentially disappeared.

Thirty years ago, I began to doubt IBM's model, but for the wrong reasons technologically. I didn't see the PC coming any more than anybody else. I saw the likelihood of the computer approaching either the telephone or the TV set or both. Which it didn't do - yet. Instead, we got the PC.

Are there any theories of information economics you respect?

Current economics is merely refining the obsolete. Economic theory is still based on the scarcity axiom, which doesn't apply to information. When I sell you a phone, I no longer have it. When I sell information to you, I have more information by the very fact that you have it and I know you have it. That's not even true of money.

Do you think there is anything to this idea of a network economy?

In any community in transition, it is more important whom you know than what you know. That's the right definition of networking. ■ ■ ■

If Marshall McLuhan is *Wired's* patron saint, then Peter Drucker should be its official oracle. Drucker has the great advantage over McLuhan in that, at age 88, he is still as astute and timely as ever. And because Drucker is a historian who also gets his hands dirty with real-life management issues, he has a reputation in the business world that is truly Olympian. Kevin Kelly made his annual trek to Drucker's ranch home in Southern California to hear what the oracle is uttering these days.



The sweep of history: Chief Joseph plays his part in *The American Adventure*; illustrations of Disney characters by an old control board (opposite) features celebrated animator Bill Justice.

BY SCOTT KIRSHNER

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The exclusive underground tour of Disney World.

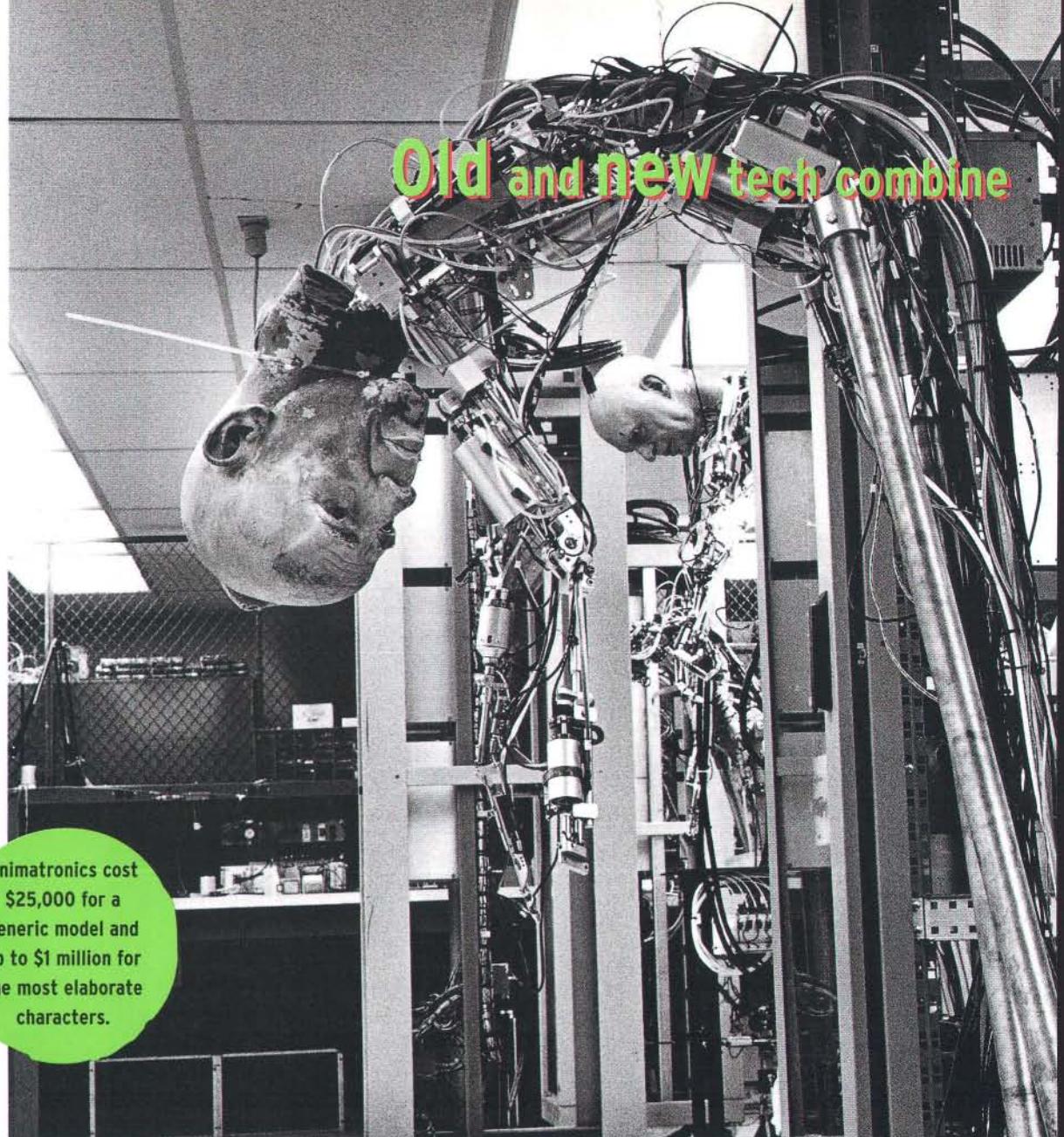
THE MAGIC



It's 10:25 on a steamy, late-summer morning in central Florida, and I'm standing on a narrow steel catwalk surrounded by an old-growth forest of American historical figures: Ben Franklin, Will Rogers, Susan B. Anthony, Frederick Douglass, and a dozen others. We're waiting for the morning run-through to begin. And it's dark down here below the stage, save for the glow from green and amber indicator lights.

Bruce Long, a Disney Imagineer who is in charge of "show quality" at the company's six theme parks around the world, is standing next to me. "Make sure you don't lean over the rails here, or you'll shut down the show," he says. "We've got indicators that keep an eye on that, so you don't get hurt by any of the hydraulic lifts going up and down." Long shoots me a look that lets me know I'm infinitely less predictable than his cast of audio-animatronic figures. Then he gives the cue for two technicians to fire the show before guests begin streaming through the gates of Epcot Center's World Showcase at 11 a.m.

Up above my head, powerful speakers begin to spout patriotic music. "America did not exist," intones Ben Franklin, launching into a 30-minute history lesson that Disney has dubbed The American Adventure. All around me, latex-skinned icons of the nation's past get their cues from a magnetic tape loop and spring to life. Thomas Jefferson drafts the Declaration of Independence. Franklin Roosevelt delivers a rousing rendition of "The only thing we have to fear is fear itself." A giant tray that holds every



Animatronics cost
\$25,000 for a generic model and up to \$1 million for the most elaborate characters.

prop and figure used in the show — Long refers to it as "the war wagon" — slides slowly toward the back of the theater. Long, a 26-year Disney veteran, watches the proceedings with the casual intensity of a jeweler. His job is make sure that Disney's industrial-strength illusions stay convincing enough to keep the crowds coming — and the dollars pouring in — 12 hours a day, 365 days a year. *Imagineering* isn't a bad word for what he does — whimsy, perfectionism, and sleekly efficient capitalism all rolled into one.

"D'you see that?" Long asks as Andrew Carnegie, Alexander Gra-

ham Bell, Susan B. Anthony, and Mark Twain rise up to stage level. "The middle lift there was doggin'! I have to shake my head. I didn't notice anything — and when the audience arrives, it's not likely anyone else will, either. But Long, with a glance, can pick out "slop" in a robot's finger movements or the "steppiness" in an arm sweep. Right now, *The American Adventure* is doing pretty well. Of the 811 animated functions on Long's checklist — every hydraulically powered nod and wave, plus smoke effects, lighting, and projections — the only problem is that sticky lift. The rating:

99.14 percent, up from the last assessment's mediocre 98.2 percent.

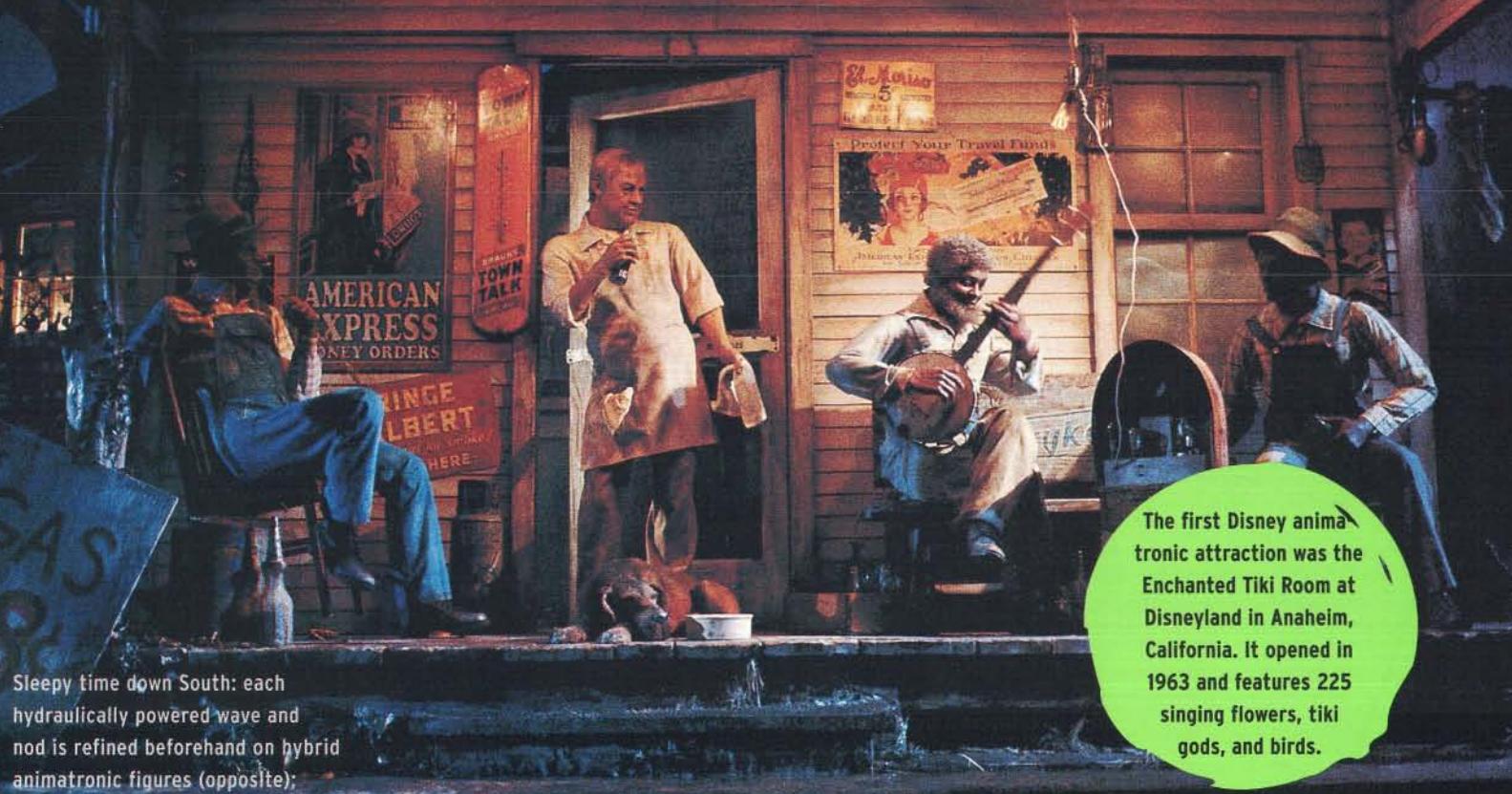
It's serious business running the most sophisticated virtual world ever created. Put on your best VR goggles and gloves, hook up to the high-powered workstation of your choice, and you'll never come close to what US\$42 a day (\$34, if you're 9 or under) gets you at one of the theme parks people like Bruce Long put together. Disney has the kind of control over visitors' experiences — what they see, smell, hear, and feel — that videogame builders can only dream of. Bran Ferren, *Imagineering*'s executive vice president and a

to produce Walt's dream of "plussed-up" reality.

U.S. POST OFFICE

DRINK

Coca-Cola



Sleepy time down South: each hydraulically powered wave and nod is refined beforehand on hybrid animatronic figures (opposite); locals listen to FDR's New Deal on the radio in The American Adventure.

Source: Disney's Information Services Department

former Hollywood f/x master, knows as much about state-of-the-art illusionmaking as anyone alive today. But Disneyland, he says, was built in 1955 "at a higher resolution with bricks and mortar than we can do using bits today."

Like its purely digital counterparts, Disney's aim is to envelop visitors – 40 million a year to Florida's Walt Disney World alone – in a seamless entertainment experience. "When you come into our park, you should leave the distractions of the outside

world behind," says Greg Emmer, vice president of the Magic Kingdom and a Disney cast member (there are no employees here) since 1968. "All this technology is just a

means to present shows and tell stories."

Show is a key word in the Disney lexicon. From the moment guests (never "customers") steer their shiny rental cars onto

the 47-square-mile property southwest of Orlando, they're part of a monumental production. The 44,000 cast members all have "roles" – even

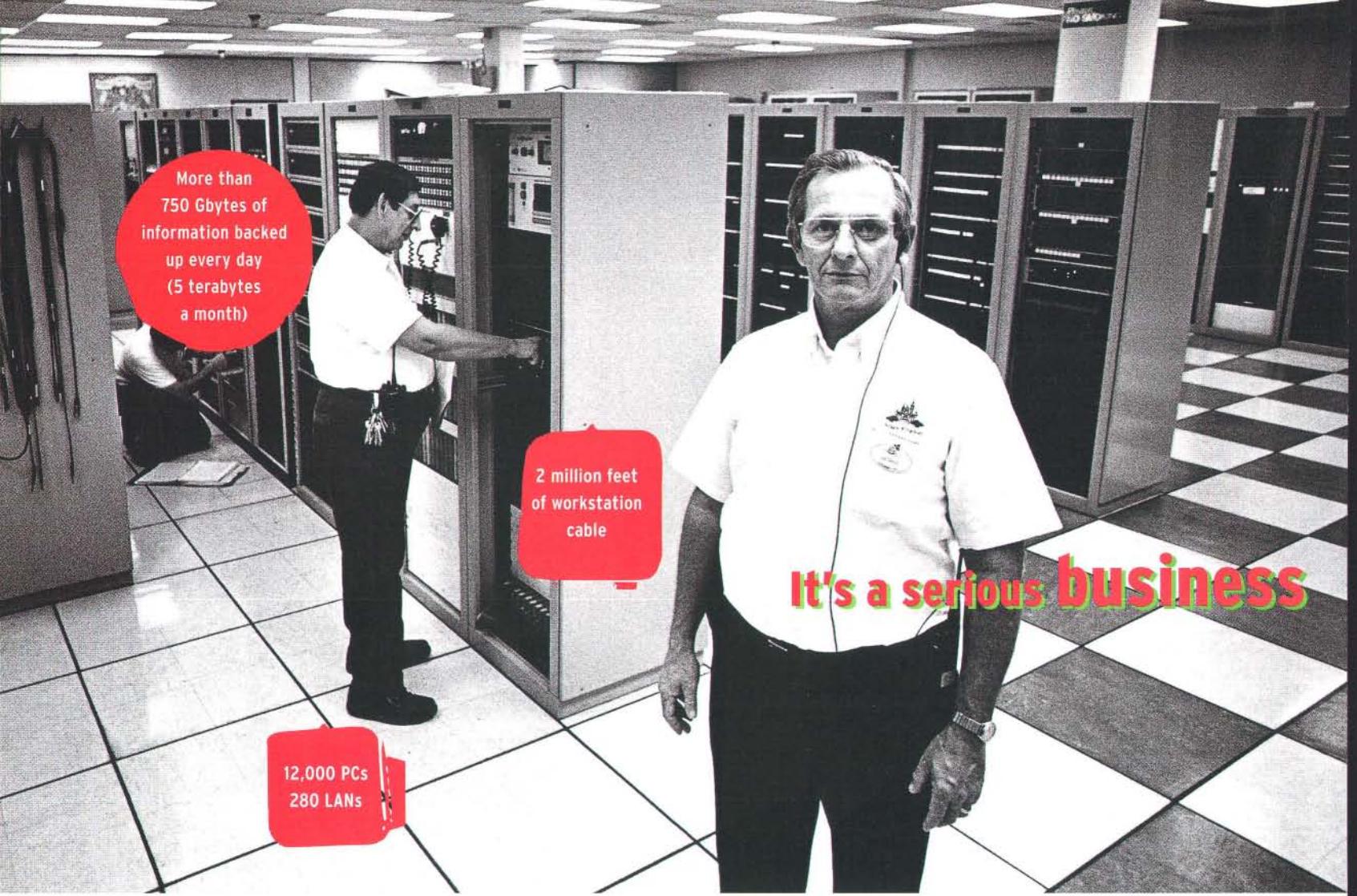
About 5,000 working parts make up the A100 robot, allowing the lifelike figure to perform 44 different movements.

the toll-booth attendant who hands you a guidebook as he collects the \$5 parking fee.

The Imagineers – based at Disney's Glendale, California, headquarters – don't want you to just step inside their world and wander around. They want to entertain you. They want to direct your attention like a master magician, mount parades that force you to stand and gawk, and engineer enough distractions into a queue area to almost make you overlook that you've waited more than an hour in the blazing sun for the privilege of climbing into a fiberglass log and

plunging down an artificial waterfall.

Every sort of show is a manufactured experience – lines are written in a script, stage directions mapped out, the lighting cues carefully rehearsed. But Disney's theme parks take the concept of "show" to a new level. This is an alternate reality, a set of illusions so complete that people happily immerse themselves for days – and come back again for more. Indeed, so compelling are Disney's virtual worlds that the real world has begun turning to the Imagineers for help in reaching its own full Disneyesque potential. The Mouse now stages Fourth of July



It's a serious business

fireworks and parades for towns "off property" (as the outside world is known), and Imagineers are leading the redevelopment of that dingiest of Main Streets, New York's Times Square. Disney put a megastore on 42nd Street and renovated the historic New Amsterdam Theater, then threw a massive parade in midtown Manhattan last summer to celebrate the release of *Hercules*. For those

seeking total immersion, the company even offers real estate in its own town, the nostalgia-enhanced planned community called Celebration, just outside Orlando. After more than 40 years in the theme-park business, Disney's enhanced reality is proving too attractive for the real world to resist.

But the Disney parks in central Florida are still the unchallenged

champs of "plussed-up" reality, to use a term that Walt loved to toss around. This is a nice euphemism for strategy worthy of a military campaign: no chewing gum is sold here, so you won't wind up with a wad on the bottom of your shoe; you're never more than 30 or so yards from a rest room, even when wandering the streets of a 19th-century gold rush town. "Disney World shows you

how seductive life can be in a situation that's totally controlled," says Stephen Fjellman, a Florida International University anthropologist and author of the book *Vinyl Leaves: Walt Disney World and America*. The heart of Disney's success, Fjellman observes, is the masterful subtlety with which it wields near-total control over the guest's experience. In fact, technology dominates

Disney Bros. Studio founded by Walter and Roy Disney.

The Disney Company goes public.

Disneyland opens in Anaheim, California. Initial investment: US\$17 million.

Walt Disney dies. His sudden absence leaves a creative vacuum that is difficult to fill.

Magic Kingdom opens in Orlando, Florida. Initial investment: \$40 million.

Epcot opens in Orlando, Florida. Initial investment: \$800 million.

Tokyo Disneyland opens. Initial investment: \$650 million.

Michael Eisner, Frank Wells, and Gary Wilson take top Disney management positions. Since then, Disney's stock has appreciated more than 25 percent annually.

The first Disney Store opens in Glendale, California. Retail sales now top the company \$2 billion a year in revenues.

Disney-MGM Studios opens in Orlando, Florida. Initial investment: \$40 million.

Disney becomes the first film studio to earn more than \$500 million in a single year.

1923

1940

1955

1966

1971

1982

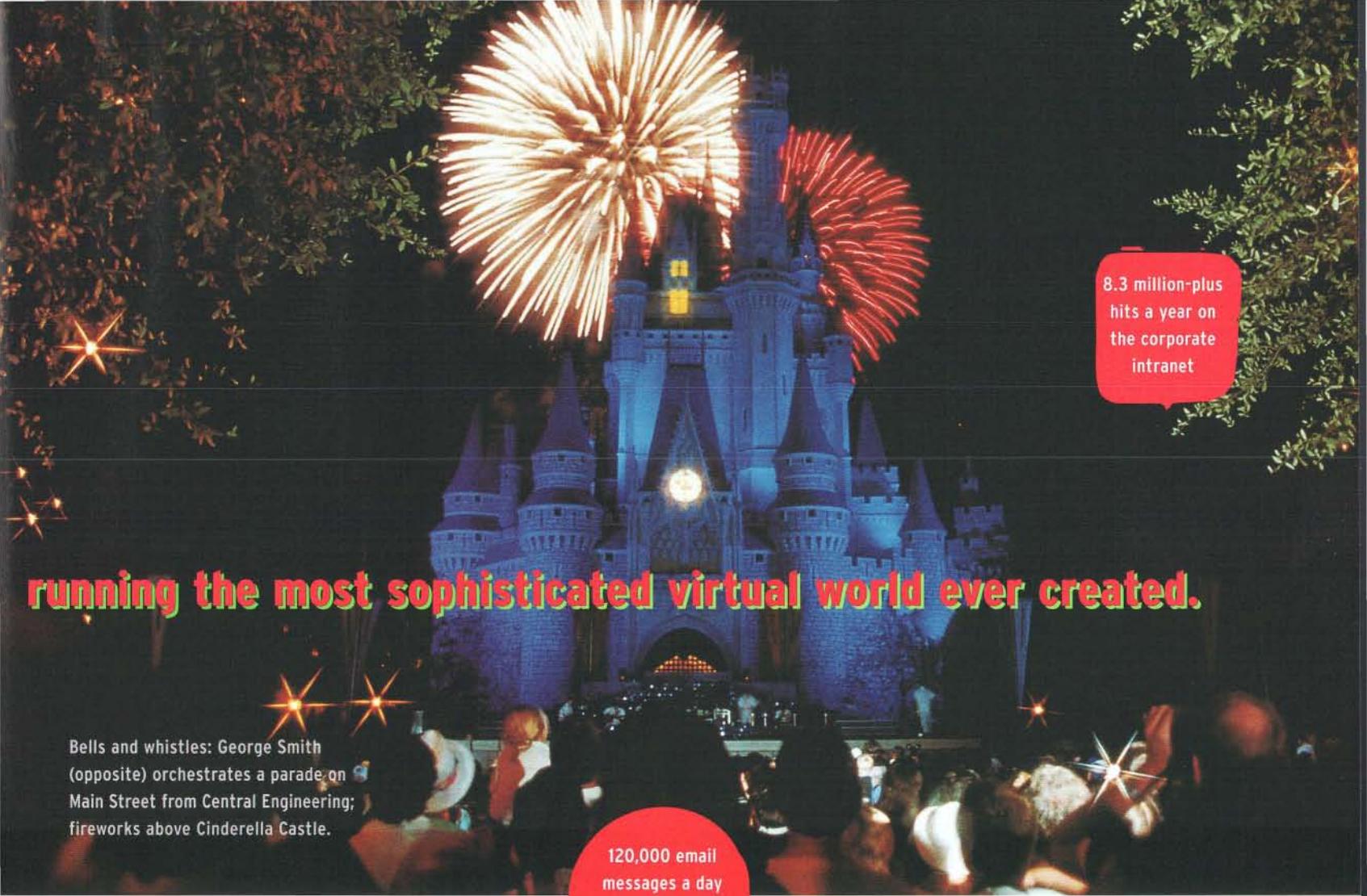
1983

1984

1987

1989

1990



running the most sophisticated virtual world ever created.

Bells and whistles: George Smith (opposite) orchestrates a parade on Main Street from Central Engineering; fireworks above Cinderella Castle.

120,000 email messages a day handled by company servers

Disney enchantment. "Backstage" at the company's parks, low-light cameras and motion sensors monitor mischief-minded guests in dark rides like The Haunted Mansion. Uniformed men pushing gas-powered vacuum cleaners show up after every parade to make the confetti disappear. A barcoded wardrobe system uses a supermarket-style scanner to check out every item

of clothing that every cast member wears and later check every piece back in for laundering. A corporate intranet helps keep cast members informed so they can better answer guest questions (a favorite: "What time does the 3 p.m. parade start?"). An infrared network even hooks up cash registers in popcorn carts to a park's financial-reporting system.

It's all designed to be unobtrusive and nearly invisible. But as a native Miamian who grew up going to the parks, that's what I really wanted to see. So I put a call in to Disney public relations, asking about access to the cast members who run Walt Disney World and the places they work. Disney came back with one stipulation: discussions about park

security were off-limits. Otherwise – to my amazement – they agreed.

I'm cruising past the security guard who monitors access to the service area behind the Magic Kingdom. Following the road around the outskirts of Main Street and Tomorrowland, we pull in to a small parking lot behind Fantasyland. This is one of the main

Disneyland Paris opens.
Initial investment:
\$4.4 billion

Disney president Frank Wells dies in a helicopter crash. Significant management reshuffles follow: Jeffrey Katzenberg leaves to form DreamWorks SKG; financial whiz Stephen Bollenbach departs to take over as CEO of Hilton Hotels.

Disney releases *The Lion King*, which becomes the company's most profitable film ever, grossing \$750 million worldwide and \$313 million in the U.S.

Disney signs deal to purchase Capital Cities/ABC Inc. for \$19 billion.

Disney president Michael Ovitz leaves Disney after only a year and a half, walking away with a compensation package worth \$38 million in cash and an estimated \$92 million in stock.

Michael Eisner exercises his Disney stock options, worth about \$565 million in profit. Eisner has earned almost \$1 billion since he arrived at Disney and still holds about 8.7 million shares' worth of stock options.

Animal Kingdom opens (spring) in Orlando, Florida.
Initial investment:
\$800 million.

Disney Cruise Lines sets sail (spring). Initial investment: \$800 million (including purchase of a 1,000-acre island in the Bahamas).

1992

1994

1994

1995

1996

1997

1998

1998

entrances to the Utilidor (utility corridor). Rather than being underground, the Utilidor is actually the first floor of the park; in Florida, the water table is never far from the surface, so a real basement isn't practical. We enter the tunnel. It's hard not to be surprised by how different the backstage areas are from what the guests see. The rendering is much lower-res back here – gray paint, poured concrete floors, and plain fluorescent lights.

It's also hard not to notice how dramatically the Utilidor shrinks things. Upstairs, Disney deploys every illusion in its formidable repertoire to make the park seem vast and spread out, to separate 19th-century Main Street from 21st-century Tomorrowland.

Here, it's efficiency they're after, and no two points in the park are more than a 10-minute walk apart. And if you're really in a hurry, you can grab an electric golf cart.

The Utilidor enables cast members to don their costumes (not "uniforms") and report to their stations without having to negotiate the crowds upstairs. And it allows technicians

easy access to the guts of the park. Wiring and piping run along the ceiling; on a recent hot summer afternoon, a pair of techies were installing a new fiber-optic line without breaking a sweat. Every 15 minutes or so, a sound like a tornado whirls by overhead: that's the park's vacuum-powered garbage system, sucking another batch to a central processor.

The Utilidor would baffle the hell out of a 5-year-old. Snow White and Alice walk by in street clothes, identifiable only by their wigs and heavy makeup. A woman in Pluto feet shuffles toward the Fantasyland cafeteria, clad in a Disney-issue gray T-shirt and shorts. Seven familiar-looking dwarf heads hang from a concrete wall. At the mouth of the Utilidor, a Tomorrowland cast member smokes a butt and unwinds.

In front of a door marked Engineering Central, we stop to wait for clearance. A biometric hand

reader on the wall, made by a company called Recognition Systems, scans the size and shape of your fingers, compares them with a template stored in a database, and makes up its mind about whether you're entitled to access. We're not in the database, so we hit the intercom buzzer instead. After a few moments, an elderly woman pushes open the door and announces, "Door's broken. Come on in."

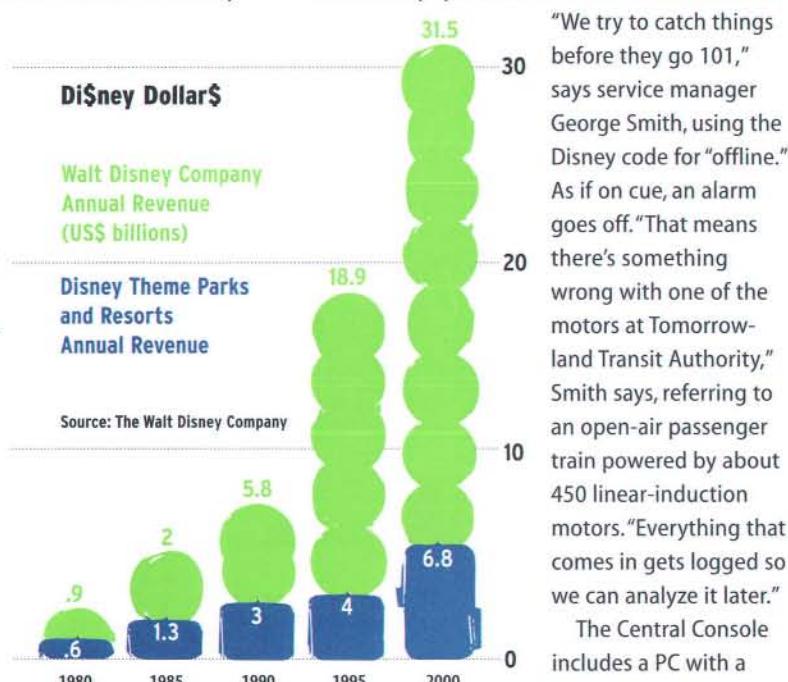
Inside, behind a bank of PCs and VT220 terminals, a handful of cast members monitor not just the operations of the Magic Kingdom's attractions, but also food-storage freezers, water pumps and wells, and lighting, fire-detection, and security systems. This is the Central Console.

"We try to catch things before they go 101," says service manager George Smith, using the Disney code for "offline." As if on cue, an alarm goes off. "That means there's something wrong with one of the motors at Tomorrowland Transit Authority," Smith says, referring to an open-air passenger train powered by about 450 linear-induction motors. "Everything that comes in gets logged so we can analyze it later."

The Central Console includes a PC with a graphic display of all

the juice that the Florida Power & Light Company is feeding to Walt Disney World. "We get a lot of power glitches from thunderstorms," explains Nick Blackwell, Engineering Central's manager. "And occasionally there are outages, despite the fact that we have redundant backup substations. If we lose power to Small World, we get an alarm here, and then we can troubleshoot it and see what the cause is. If we need to, we pick up the hot line to the folks at Reedy Creek Energy Services," part of the Reedy Creek Improvement District, a nominally governmental body that Disney created (with approval from Florida's eager legislators) to oversee its property. Reedy Creek has its own two generators – gas turbine and steam turbine – and enough leeway from Florida's tourism-hungry state government in Tallahassee to build a nuclear plant if Disney so desires.

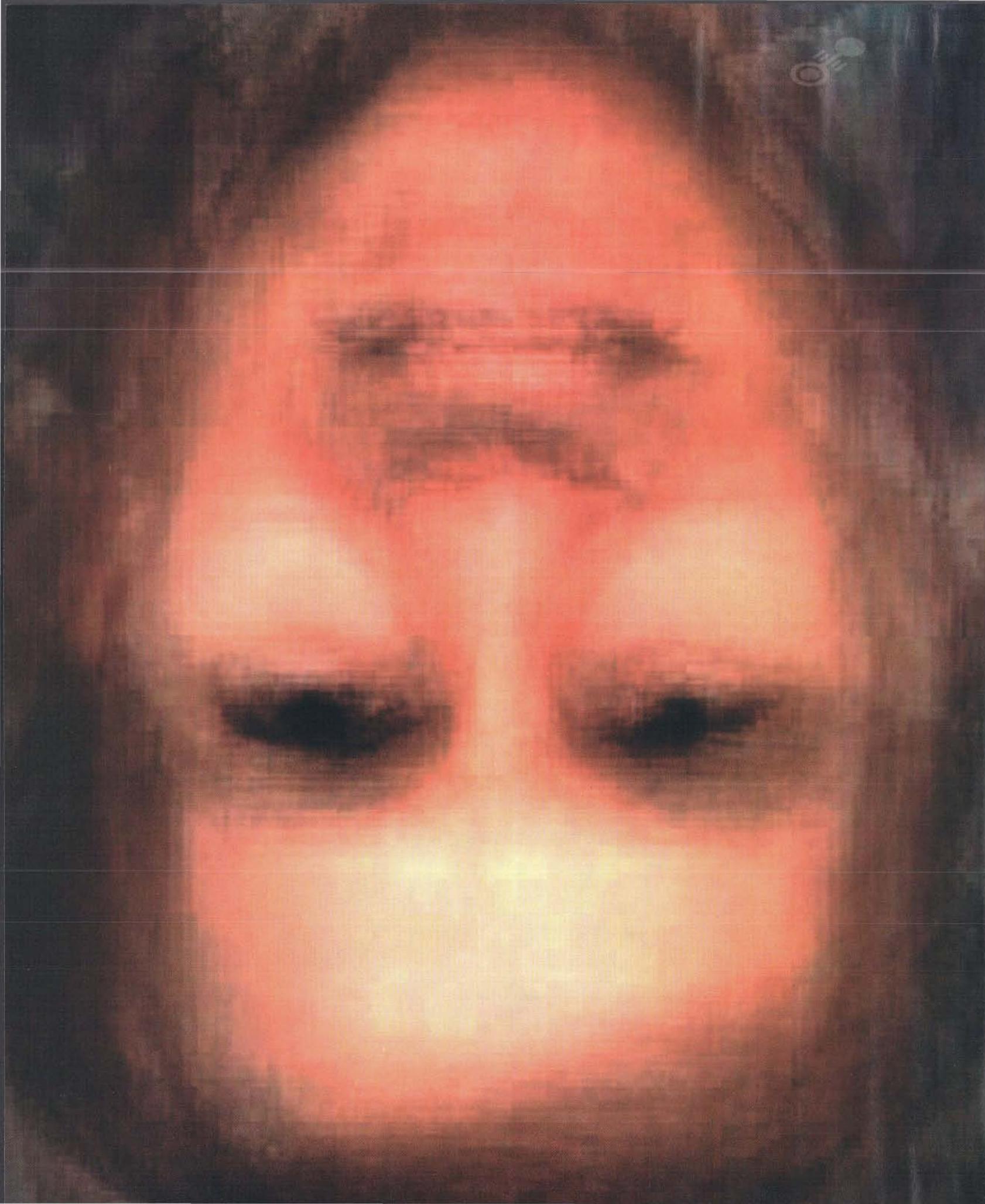
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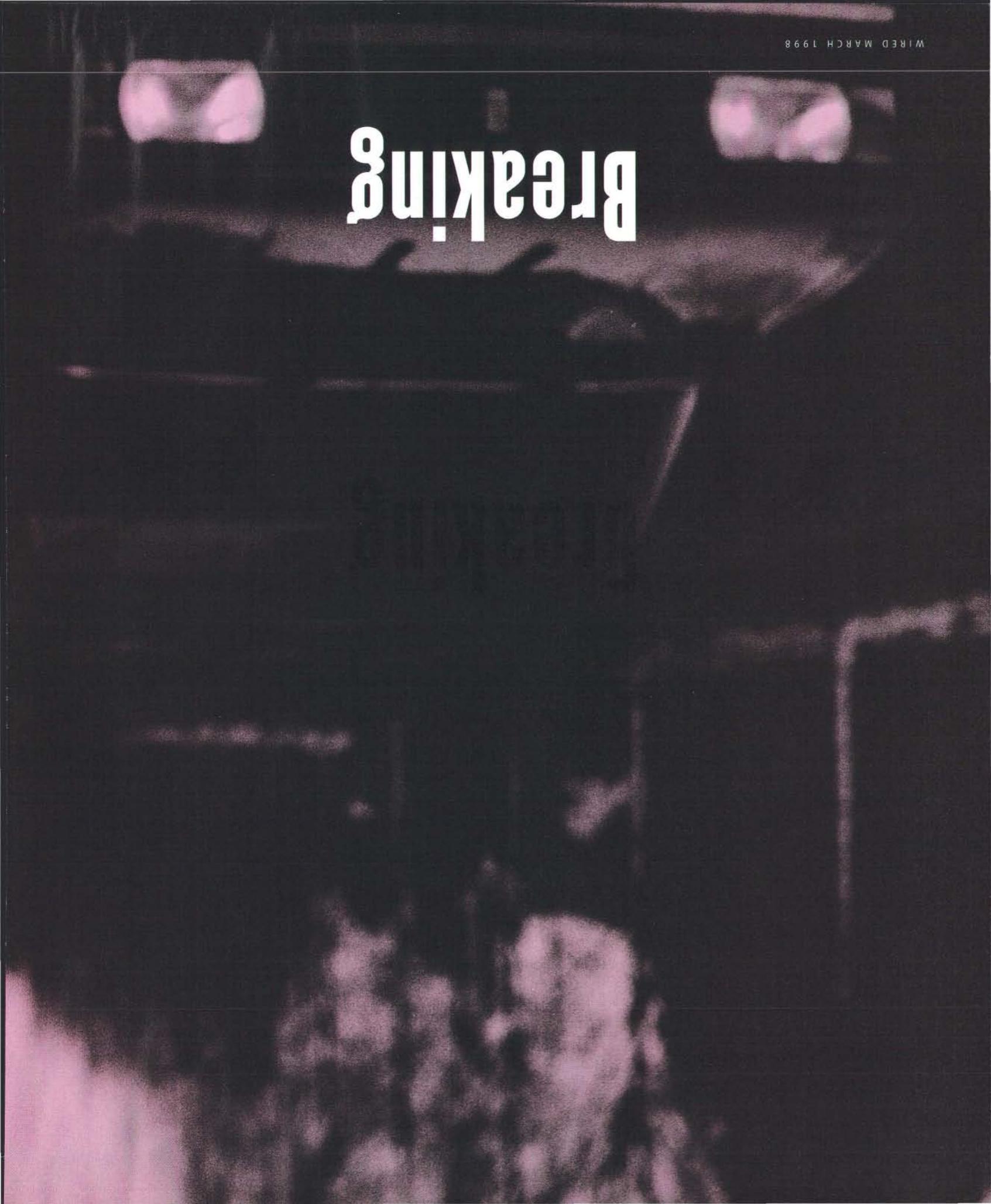
WE THE PEOPLE

As a PhD candidate in artificial intelligence at Carnegie Mellon, Astro Teller decided to explore the many faces of American culture. Armed with databases, a digital camera, and face-recognition software, Teller and designer Christopher Pacione created *Jedermann*, a two-part collection of composite portraits. The first features visitors to a Pittsburgh gallery and a Web site (www.cs.cmu.edu/afs/cs.cmu.edu/user/astro/mosaic/JEDERMANN.html). The second focuses on various cultural icons; pictured here is a composite of sitting US Democratic senators. "The collective visages act as psychological mirrors," Teller tells us. "This is the friendly, make-you-feel-included face of someone trying to prove he's one of us."

– Rachel Lehmann-Haupt



Breaking



Gravity

Now, as Charles Plat

is back and unrepentant,

discoveries, Eugenie Podkletnov

But the controversy hasn't gone
away, as his findings began to
be investigated in laboratories
around the world, including one
owned by NASA.

Podkletnov withdrew the article.
His university evicted him.
He retreated from the public eye.

Then a London newspaper
publicized his conclusions,
and the skeptics had a field day.
Everyone knew you couldn't
mess with the law of gravity —
Einstein himself had said so.

In 1996, Russian emigre
scientist Eugenie Podkletnov
was about to publish a peer-
reviewed article in the respected
British Journal of Physics D —
proving, he claimed, that gravity
could be negated.

the Law of

Eugenie
Podkletnov
resurfaced
in Tampere,
Finland,
after months
of hiding.
Photo by
Steve Double,
December
1997.

S

hortly before dawn on a dismal, rain-drenched winter morning I'm heading out of Helsinki along Highway 3, into the heart of Finland. This obscure nation is an underpopulated wilderness sandwiched like a DMZ between Russia and Sweden, extending all the way up into the Arctic Circle. The sun barely sets here in the summer, while in the winter, it barely rises. I can't imagine why anyone would visit Finland in the dark months, unless motivated by some strange need to go skiing in perpetual twilight ... but my grueling pilgrimage has nothing to do with snow. I've come in search of a singular individual, a reclusive, elusive Russian émigré scientist named Eugene Podkletnov, who claims that he can defy the force of gravity.

Five years ago, while testing a superconducting ceramic disc by rotating it above powerful electromagnets, Podkletnov noticed something extremely strange. Small objects above the disc seemed to lose weight, as if they were being shielded from the pull of Planet Earth. The weight reduction was small – around 2 percent – but nothing like this had ever been observed before. If the shielding effect could be refined and intensified, the implications would be immense. In fact, practical, affordable gravity nullification could change our lives more radically than the invention of the internal combustion engine.

Imagine a future in which vehicles can levitate freely.

Highways and railroads become obsolete, airplanes no longer need wings, and oceangoing ships can be broken up for scrap. Industries in which large masses have to be transported or supported – from mining to construction – are revolutionized. Citizens gain unprecedented mobility, transcending all geographical and national barriers.

Meanwhile, space travel is now safe, cheap, and fast. Resources can be mined in the asteroid belt and shipped to factories relocated

in orbit around Earth, freeing our planet from pollution and greenhouse-gas emissions. Ultimately the old dream of colonizing other worlds may be realized, not just for a handful of highly trained astronauts but for millions of everyday people.

Far-fetched? Indeed. Most physicists laughed at Podkletnov's report. Riley Newman, a professor of physics at UC Irvine who has been involved in gravity research for 20 years, typified the reaction when he commented, "I think it's safe to say gravity shielding is not conceivable." Like many scientists, he felt that Podkletnov must have made a mistake, measuring magnetic fields or air currents instead of genuine weight reduction.

And yet, few of Podkletnov's critics actually bothered to read his description of his work. Their reaction was so dismissive, it almost sounded like prejudice. From their perspective he was an outsider, a nonmember of the "gravity establishment." They couldn't believe that a major discovery in physics had been made by such a no-status dilettante fooling around at some obscure lab in Finland.

True, Podkletnov wasn't a physicist – but he did have a doctorate (in materials science) and he knew how to do careful lab work. When he wrote up his results, his papers were accepted for publication in some sober physics journals, and at least one theoretical physicist – an Italian named Giovanni Modanese – became intrigued. Modanese didn't dismiss the whole idea of gravity shielding, because on the subatomic level, we simply don't know how gravity functions. "What we are lacking today," according to Modanese, "is a knowledge of the microscopic or 'quantum' aspects of gravity, comparable to the good microscopic knowledge we have of electromagnetic or nuclear forces. In this sense, the microscopic origin of the gravitational force is still unknown." At the Max Planck Institute in Munich, he developed a theory to explain the shielding phenomenon.

In the United States, scientists affiliated with NASA were thinking along similar lines. They obtained funding to replicate Podkletnov's experiment – but still the skeptics remained cynical and unimpressed. The concept of gravity shielding has an aura of science-fictional weirdness; it sounds like something out of *The X-Files*. Indeed, Podkletnov's experiment was actually mentioned in an episode of *The X-Files*, virtually guaranteeing that most scientists wouldn't take it seriously.

Charles Platt (cp@panix.com), a frequent contributor to Wired, wrote "Plotting Away in Margaritaville" in Wired 5.07.

Super-conducting ceramic discs rotated above electromagnets shield small objects from the pull of Planet Earth.

G

avity shielding isn't a new idea. H. G. Wells explored its potential for spaceflight almost a century ago in his classic novel *The First Men in the Moon*, and Wells also foresaw an avalanche of applications on Planet Earth, creating an uneasy conflict between pure science and pure greed. In his novel, a lone mad scientist says he isn't in it for the money; he just wants some recognition, and maybe a prize or two. But then he starts to realize *just how much* money could be involved. "I suppose," he says thoughtfully, "no one is absolutely averse to enormous wealth."

Eugene Podkletnov must be aware of this - but so far, he has reaped more pain than profit. After publishing a preliminary paper in 1992, he wrote a more thorough paper that was rejected by more than a dozen journals till finally it penetrated the peer-review process at the respected British *Journal of Physics-D*. This seemed to offer the recognition he was hoping for, yet instead it initiated a career-destroying nightmare.

The trouble started when Robert Matthews, science correspondent to the British *Sunday Telegraph*, got hold of the story. Matthews, like any journalist, relies on contacts, and he's disarmingly honest about it. "You don't get stories by digging for them," he now says with a laugh. "This isn't like Sherlock Holmes, that's a lot of bollocks. It's like, you hope a little brown envelope turns up in the post, and if it does, you're in luck."

In his case the little brown envelope contained page proofs of Podkletnov's paper, leaked by a man named Ian Sample who worked on the editorial staff of the *Journal of Physics-D*. Although Podkletnov's paper hadn't been published yet, Sample and Matthews decided to break the story in the *Sunday Telegraph*, which printed it on September 1, 1996. The first sentence was key: "Scientists in Finland are about to reveal details of the world's first antigravity device."

Antigravity? Podkletnov never used that word; he said he'd found a way to *block* gravity. Maybe this seemed a trivial distinction, but not to the staid professors at the Institute of Materials Science in the University of Tampere, to whom "antigravity" sounded like something out of a bad Hollywood movie.

The director of the institute promptly denied any involvement and declared that Podkletnov was working entirely on his own initiative. Then the coauthor of Podkletnov's paper claimed that his name had been used without his knowledge - which was highly implausible, but he stuck to his story, presumably because the institute told him to. In the end Podkletnov had to withdraw the paper from publication in the journal, he was abandoned by his friends, and his credibility was impaired.

At this point I obtained Podkletnov's phone number in Tampere and gave him a call. He turned out to speak fluent English but was reluctant to say anything, claiming that irresponsible journalism had ruined his career. I gave him various assurances, faxed samples of my work, made more calls - and finally, on November 10, 1996, he gave me a telephone interview.

He told me how he had made his discovery. "Someone in the laboratory was smoking a pipe," he said, "and the pipe smoke rose in a column above the superconducting disc. So we placed a ball-shaped magnet above the disc, attached to a balance. The balance behaved strangely. We substituted a nonmagnetic material, silicon, and still the balance was very strange. We found that any object above the disc lost some of its weight, and we found that if we rotated the disc, the effect was increased."

I had no way to evaluate the truth of this, so I contacted John Cramer, a physicist who was familiar with the story. "I don't believe he has discovered a shield for gravity," Cramer told me, insisting that huge amounts of energy would be required.

I checked back with Podkletnov. "We do not need a lot of energy," he said, sounding irritable, as if I were wasting his time with dumb, obvious questions. "We don't absorb the energy of the gravitational field. We may be controlling it, as a transistor controls the flow of electricity. No law of physics is broken. I am not one crazy guy in a lab, we had a team of six or seven, all good scientists."

So who should I believe? Maybe if I met Podkletnov in person, I could assess his plausibility – but a few days later, he told me this was impossible. In fact, he said, he had decided that he wanted no further publicity of any kind.

This put me in an impossible position. Podkletnov had talked to me, originally, because I pledged to publish nothing about him without his consent. Now that he had withdrawn his consent, I simply had to honor my pledge. Temporarily at least, I abandoned the story.

**"We may be
controlling
the gravitational field,
as a transistor controls
the flow
of electricity,"**
says Podkletnov.

**"No
law of
physics
is
broken."**

M

onths passed. Once in a while I sent email to the Italian physicist, Giovanni Modanese, who seemed to know where Podkletnov was hiding, but Modanese just confirmed that the reclusive Russian still wouldn't talk. Finally, by chance, I read a Usenet message from a 34-year-old software developer in Oregon named Pete Skeggs, who turned out to be a pivotal figure in a newly emergent Net phenomenon: the gravity-enthusiast underground.

Skeggs had a BS in electrical engineering, a BS in computer science, and he loved to tinker with things. In his own little workshop he had tried to replicate Podkletnov's experiment using some homemade electromagnets and a 1-inch superconductor that he ordered from the Edmund Scientific mail-order catalog for US\$24.95. He didn't get any results, but decided to start a gravity-modification Web page. Soon it was a huge repository of abstracts, speculation, and references, along with reports of work by other amateurs, some of whom claimed amazing results. A man named John Schnurer, at Antioch College, Ohio, said that his homemade setup could reduce the force of gravity by 2 percent on a reliable, repeatable basis.

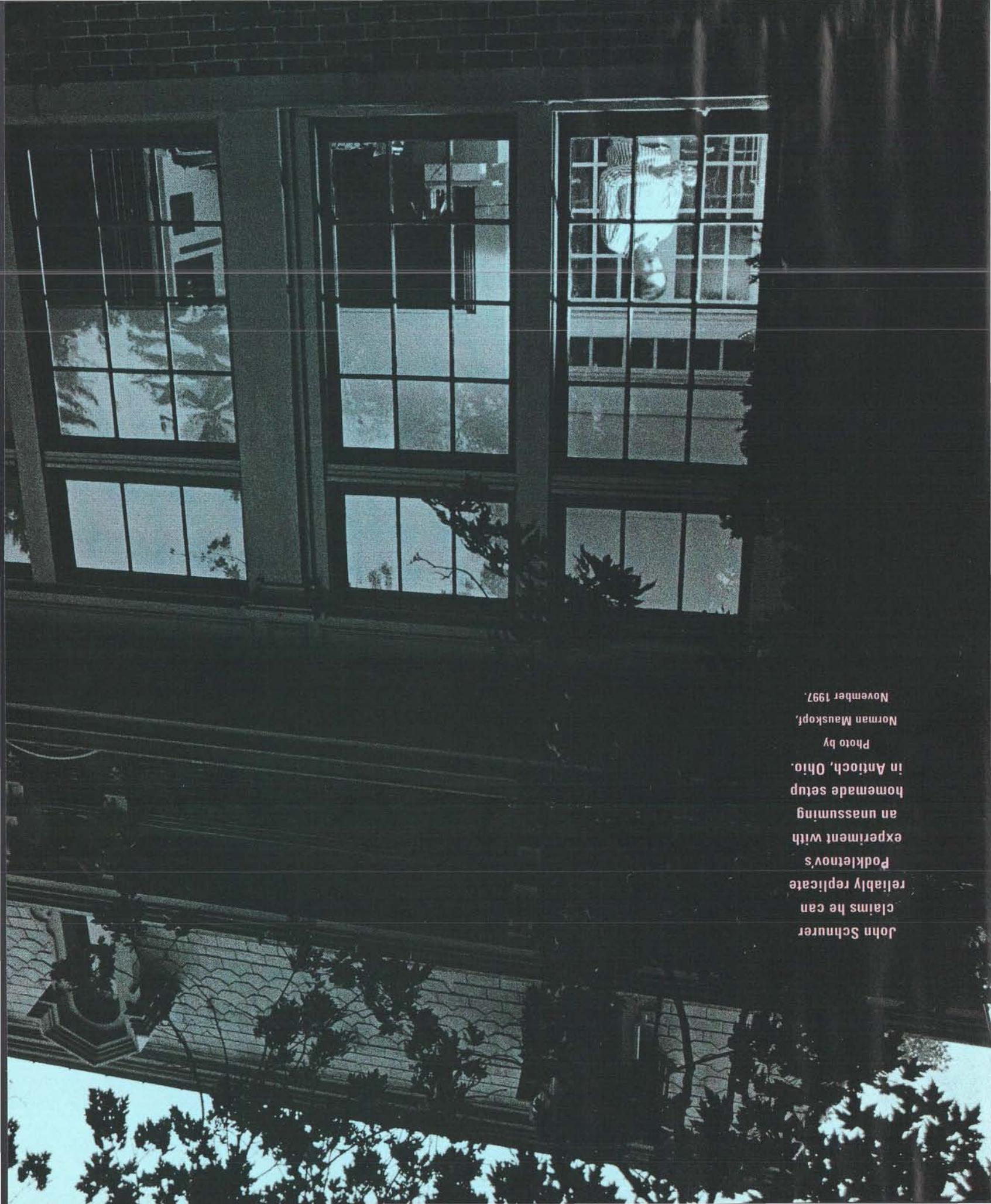
I sent email to Schnurer; he replied enigmatically, refusing to divulge his home or office phone numbers and insisting that I must page him, after which he would call me back. On September 17, 1997, he returned one of my calls.

Aged 45, Schnurer said he had a "strong science background," though he admitted he had no college degree. He claimed to have coauthored "more than 12 peer-reviewed papers" and had spent "more than nine years providing tech support for Armstrong Aerospace Medical Research Labs at Wright-Patterson Air Force Base," where they had been trying to find ways for pilots to control airplanes via brainwave sensors. "We had a flight simulator," Schnurer said. "You could sit in it and make it roll with your brainwaves." However, he'd been laid off in 1995 because of budget cuts, and he was frank about his current problems. "I don't have any money," he said. "Most of my equipment I built myself, or borrowed, or resurrected." Still, he claimed that his redesigned version of Podkletnov's setup was working on a routine basis and could be used onboard Earth satellites to make small orbital corrections.

Was Schnurer for real? He agreed that I could visit him, so I arranged for *Wired* photographer Norman Mauskopf to meet me in Ohio. A couple of days before my trip I contacted Schnurer just to check that there were no snags, and he assured me his apparatus was still up and running. "I have enough liquid nitrogen for one run, maybe two," he said.

This made me suspicious. Two demos would be just enough to show some results, while preventing a more thorough investigation. I sent email asking Schnurer to obtain more liquid nitrogen. I even told him that if he didn't have enough money, I'd pay for it myself.

John Schnurer
claims he can
reliably replicate
podkletnoys
experience with
an unassumming
homemade setup
in Antioch, Ohio.
Photo by
Norman Mauskopf,
November 1997.



The liquid nitrogen

boils violently at
room temperature.

“Now!” says Schnurer,
lowering the
target mass
in the
Dewar flask.

Two hours later, he called me. “Can you wire me the cash via Western Union?” he said. “I need \$150.”

Well, I’d been dumb enough to make the offer, and I was determined to witness a thorough trial; so I sent the money. Two days later I was in a rented car with Norman Mauskopf, driving across the flat farmland of Ohio to Antioch College, just south of Dayton.

We found Schnurer in a fine old red-brick residence with white-painted casement windows and a big front porch. This turned out not to be his home; the place had been divided into offices. Schnurer’s workshop was in a long, thin sunroom where a white-painted wooden bench left barely enough space for people to squeeze past each other. The bench was strewn with components, tools, computer circuit boards, books, and looseleaf binders. At the far end stood the Gravity Modification Machine.

A long wooden rod was pivoted on a nail, supported by a wooden yoke glued to a block of plywood. A piece of string dangled from one end of the rod, tied around a lump of scrap metal. At the other end a tangle of fine wires ran down to some coils underneath a 1-inch black disc – a superconductor that had been donated by a local manufacturer, thus saving Schnurer the \$24.95 charged by Edmund Scientific. When I asked why he had to economize so stringently, he muttered something about his family not fully sharing his enthusiasm for gravity research.

The wires from the electromagnets snaked back to a 12-volt power supply, via a “switching system” consisting of bare copper contacts that had to be maneuvered by hand. “You can’t photograph that,” Schnurer said firmly. “That’s an integral part of my patent application.”

I stared at his apparatus in dismay. Even straining my creative powers to the limit, clearly there was no way to portray this as cutting-edge science. The components looked as if they’d been salvaged from a dumpster.

Schnurer, however, was eager to begin. He showed me his “target mass” (a bundle of seven glass rods), which he placed ceremoniously

on a borrowed digital scale. He noted the readout: 27 grams. Then he picked up a small tank of liquid nitrogen – *my* liquid nitrogen, I realized, feeling a bit pissed about it – and he poured a portion into a Dewar flask. The liquid hissed like oil in a hot frying pan as it boiled violently at room temperature. We waited a few minutes for the clouds of white vapor to die down.

“Now!” said Schnurer. He lowered the electromagnets, disc, and target mass into the Dewar flask, to cool the disc so that its electrical resistance would diminish to zero. Then he placed the lump of scrap metal on the scale, to read the difference in weight between it and the assembly in the Dewar flask. The numbers flickered wildly, responding to thermal currents in the liquid, air currents in the room, vibration from a truck passing on the road a couple hundred feet away, and a dozen other random factors. Still, a substantial weight reduction would make these small fluctuations irrelevant. “We’ll call the weight 20.68,” Schnurer said, scribbling the figure.

He went to his copper contacts and started manipulating them to send pulses to the electromagnets. I watched the scale – and suddenly felt as if reality was warping around me, because the numbers began changing. According to the scale, *the target mass was getting lighter*.

“Write down the peak value!” Schnurer alerted me.

The numbers were still jumping, but I averaged them as well as I could. Schnurer grabbed his scrap of paper, did a subtraction, divided the result by the original weight of the target mass, and got his answer: here in this funky little workshop, the force of gravity had just been reduced by 2 percent.

“Let me try that,” I said, pointing to the copper contacts. Schnurer stepped aside, looking somewhat reluctant; but when I did what he had done, the results were the same.

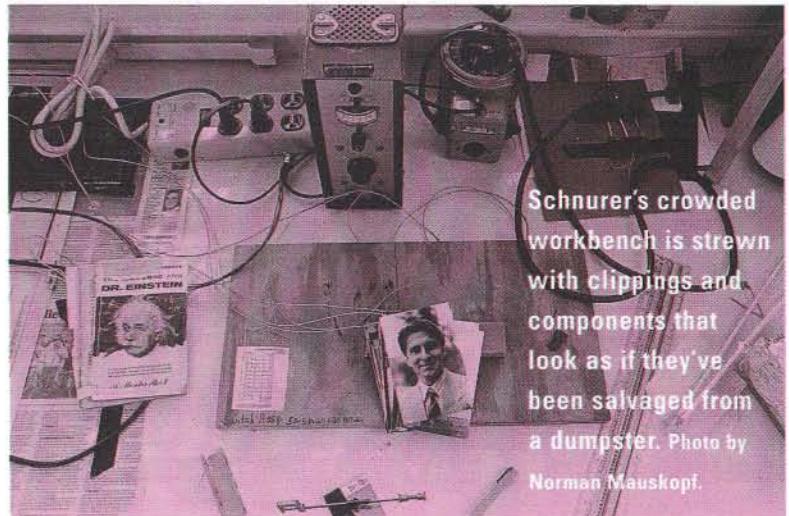
“Maybe you should take a look over here,” Norman Mauskopf remarked, nodding toward the superconductor where it dangled in the liquid nitrogen. I realized with chagrin that I had been totally hypnotized by the red LEDs on the scale. When I turned my attention to the flask, I saw what I should have seen before: electricity flowing through the submerged coils was creating heat that made the frigid liquid boil. Just as eggs bounce around when you boil them in a saucepan, the superconductor and its target mass were being lifted by bubbles. We weren’t measuring gravity reduction, here, we were conducting an experiment in cryogenic cookery!

I pointed this out to Schnurer. He looked annoyed – then indifferent, and I realized that there was still no doubt in his mind, because he was a True Believer. He *knew* he was modifying gravity. “So we’ll lift it out of the liquid nitrogen,” he said. “It’ll stay cold enough for the effect to work for 15 or 30 seconds. And you’ll see, it will still get lighter.”

B

ack in New York, three pieces of email from John Schnurer were already waiting for me. With urgent sincerity he claimed there had been a series of unfortunate errors. The superconductor had become degraded! The results I'd witnessed were invalid! He begged me to return to Ohio right away, to witness a whole new series of experiments with a brand-new disc.

Well – thanks, but no thanks. I didn't relish another session of Skeptic versus True Believer. I felt sure that it wouldn't work out



Schnurer's crowded workbench is strewn with clippings and components that look as if they've been salvaged from a dumpster. Photo by Norman Mauskopf.

We tried it, and sure enough the assembly lost weight. But it had dragged some liquid nitrogen with it from the flask, and was steaming madly. This was now the source of weight loss, just as damp clothes become lighter as they dry on a washing line.

"John, you're not measuring gravity fluctuations," I told him. "You're measuring the effects of boiling and evaporation."

Schnurer was now visibly agitated. He wanted to run the experiment again. And again. He varied the target mass, scribbled more numbers on odd scraps of paper – after a while there were so many scraps, he lost track of which was which. For several hours he tried every conceivable configuration.

While waiting patiently to see how long it might take him to admit defeat, I noticed a page from *Business Week* lying on his workbench. It was an article about gravity modification, mentioning Schnurer's work, illustrated with a photograph taken right here in this cramped little hobby-den – although false color and a wide-angle lens made the place look like a futuristic laboratory. Then I scanned the text and realized that this writer possessed the creative powers that I so sadly lacked. He seemed cautious and objective yet made Schnurer sound like a fully qualified scientist, even identifying him as "director of physics engineering at Antioch College."

I queried Schnurer about this. Gruffly he told me that he has never been employed by Antioch University; his workshop just happens to be near Antioch. With several partners, he runs a very small company named Physics Engineering, of which he's a director. Only in this sense can he be termed a director of Physics Engineering.

Around 9 p.m., we called it quits. I didn't enjoy being a heartless skeptic, questioning John Schnurer's credentials and debunking his dreams of refuting Einstein. I just wanted to go home.

For additional information:

Pete Skeggs's gravity information page:
www.inetarena.com/~noetic/pls/gravity.html

James Woodward's mass-reduction theory:
www.npl.washington.edu/AV/altvw83.html

Antigravity mailing list:
www.in-search-of.com/

John Schnurer's Gravity Society:
www.gravity.org/

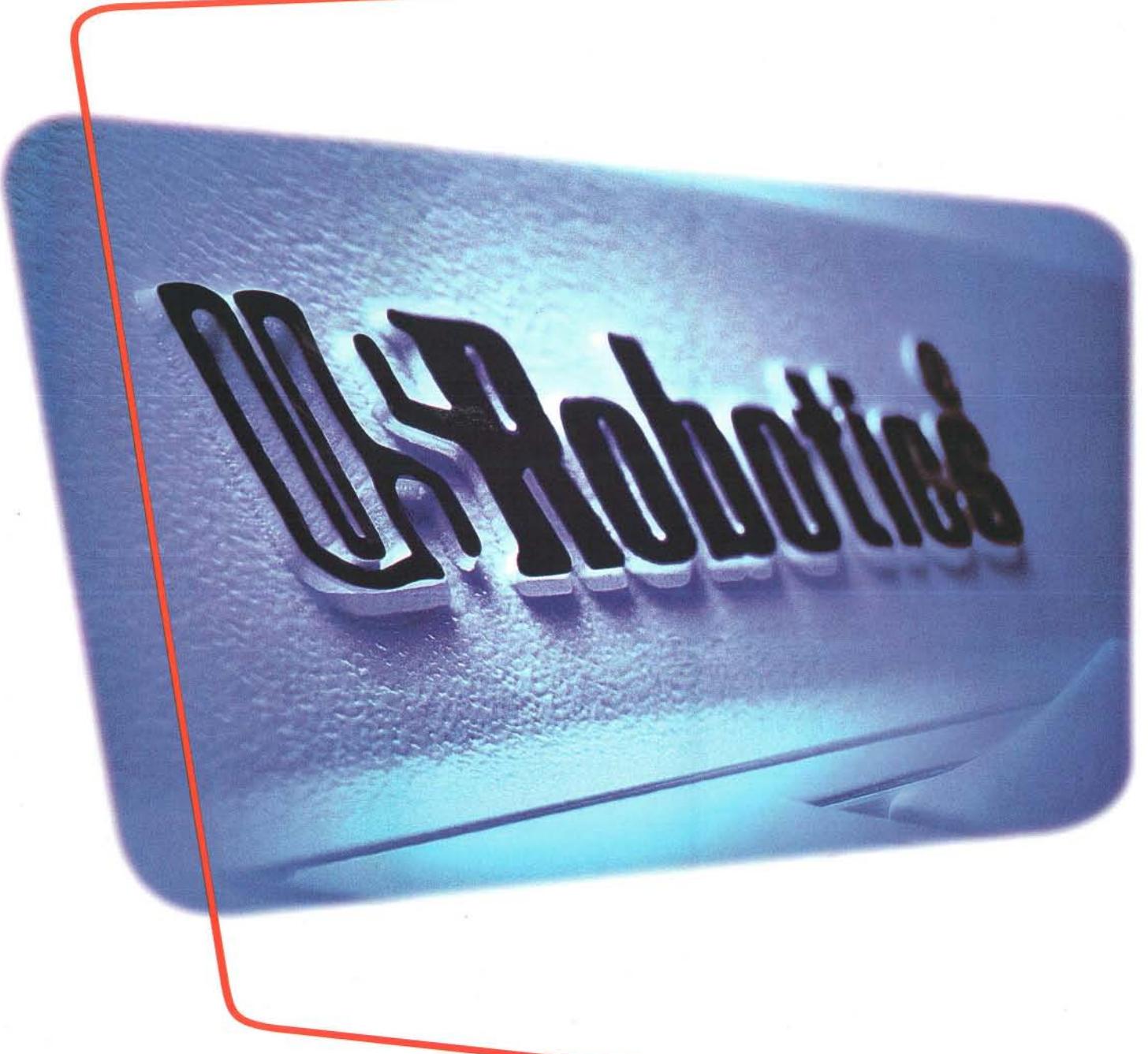
NASA's breakthrough propulsion physics program:
www.lerc.nasa.gov/WWW/bpp/

any better the second time around, and it wouldn't make either of us very happy. Instead, I followed up another reference from the indefatigable Pete Skeggs, and learned the strange history of NASA's involvement in gravity-shielding research.

In 1990 a senior scientist at the University of Alabama named Douglas Torr started writing papers with a Chinese woman physicist named Ning Li, predicting that superconductors could affect the force of gravity. This was *before* Eugene Podkletnov made his observations in Tampere, so naturally Li and Torr were delighted when they heard that Podkletnov had accidentally validated their predictions. Their university enjoyed a good working relationship with the Marshall Spaceflight Center in Huntsville, where they eventually persuaded NASA to start a serious long-term investigation. Ning Li remained involved, while Douglas Torr relocated to South Carolina.

Skeggs now forwarded to me an amazing document suggesting that Torr had ventured into even stranger territory. The document was *Antigravity News and Space Drive Technology*, an amateur zine that looked like a 1970s counterculture manifesto, generated on an old daisywheel printer, pasted into pages, photocopied, and stapled down the left edge. This science-oriented samizdat was a

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◀ 150 pain from their daughter's death. But when Walken explained his cloning experience at the primate center, and added the idea of implanting the baby's DNA in a donated egg from another woman - one who had borne healthy children - the couple started to come around. By the next afternoon, they had decided to try it. "They explained the procedure to us and said that they needed to start work as soon as possible to make sure our daughter's DNA was fresh and undamaged - that she was still, in a sense, 'alive' in her genes, but lost without a body," says Virginia Hytner. "Amanda and Adam made me and my husband believe that they could give our daughter back her body." At that point, the Hytners were sworn to secrecy.

The team of five doctors - Koteas, Walken, Mortensen, Stoltz, and Gomez - plus a handful of trusted graduate student assistants, set to work culturing the child's cells, chemically returning them to their embryonic state using samples of the advanced demethylating drugs Walken had procured from the primate center. According to Koteas, they also "obtained" frozen human eggs from the gene clinic, checking them again and again for the donor's history and any possible disease traits.

After fusing a dormant cell nucleus with a donor egg, the doctors jolted the egg with electricity to see whether it would divide. After only 10 tries, an egg started dividing normally, and Koteas implanted it in Virginia Hytner.

Over the next nine months occurred one of the most closely watched pregnancies on record. All five doctors on the cloning team made trips from Pennsylvania to California to monitor Virginia Hytner's progress. By then the Hytners were already calling the growing fetus Katy, a name they'd selected for their first child, who they later started to think of as Katy's lost twin. In fact, the university team had already coined the term *serial twins* to refer among themselves to the products of the cloning process.

In late November 1999 Virginia and Christopher Hytner took leaves of absence from work and, accompanied by Walken, flew to Philadelphia one more time. At 1 a.m. on December 5, Katy Hytner was

delivered by Dr. Albert Gomez via cesarean section. The team was elated, and the Hytners were speechless. "Our daughter was returned to us," says Christopher Hytner. "It was the miracle we'd prayed for."

Since their work had not been approved by the university, the cloning team kept all their records confidential, hidden in a filing cabinet in Koteas's office. Still sworn to secrecy, the team went back to its work at the university and the Hytners returned to California with Katy. Team members still made regular monthly visits to Pacifica to check on mother and child, who both appeared healthy and safe. The reality of the unprecedented experiment remained protected from public scrutiny for almost two years.

Then, last November, a chain of events began that revealed the Hytners' secret. Alice DeWitt, a graduate student who had worked on the cloning team screening donor eggs, filed for divorce from her husband. During the stormy divorce proceedings, Matthew DeWitt found a set of notes - copies of papers Alice had given to Koteas - while he was removing his wife's belongings from their apartment. Matthew, himself a pediatrician, recognized the implications of the notes and offered them through his lawyer for sale to the highest bidder.

When news crews from the Hard Copy cable network began scouring preschools in Pacifica for Katy Hytner, the members of the University of Pennsylvania cloning team knew they had to make a public announcement. "We could see how things were going," says Koteas. "HCTV was turning Katy's birth into a Frankenstein story, portraying her as some frightening freak of science. As bad as things are now, we knew that if we didn't get hold of the story, the Hytners' lives would be ruined forever."

Koteas's press conference was beamed live around the world on CNN, MSNBC, HCTV, C-Span, and all 10 major broadcast networks. By then, the Hytner family had left Pacifica, and if anyone on the cloning team knows the family's whereabouts, they aren't saying.

Aside from the media, a number of other interested parties would like to find the Hytner family - among them Baby Gap, Pepsi, Benetton, and the Xerox Corporation, 182 ▶

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Now that human cloning has moved from science fiction films and research labs to the real world, what are we to make of it? No one seems to know yet. Dr. G. Richard Seed's operation, which moved from Chicago to San José, Costa Rica, in mid-1999 in response to pressure from the US government, has generated some interesting new approaches to large-scale cell culturing and fine DNA manipulation, but the facility has yet to bring any of its attempted pregnancies to term. Most of the European Union's member nations have passed strict laws preventing human-cloning work, though England and Germany remain holdouts. But it's generally known that Russia, Japan, and South Korea are setting up their own experimental cloning centers, perhaps in cooperation with Seed's lab.

One of the few unambiguous responses so far to Katy Hytner's birth has come from the Vatican, which released a statement urging people to recognize that clones have individual souls, even if they occupy identical bodies. Little else about what some are calling the Philadelphia Project is certain, even whether Katy is, in fact, a legitimate clone of her dead sibling.

Since she was produced in an egg that carried another woman's mitochondria, some scientists, including geneticists at MIT and Oxford University, question whether Katy can be truly considered a clone of the Hytners' first child. Perhaps the term *serial twin* is about to become common currency as Koteas and her colleagues try to calm a nervous public that, while admiring the motivations and technical skill of the cloning team, isn't sanguine about letting this genie out of the bottle.

"No one's about to start mass-producing copies of Adolf Hitler or rich people," assures Koteas. "This is one little girl — deeply loved by her ordinary mother and father. Trust me. There's nothing to worry about." ■ ■ ■

Dr. Janet Barron contributed research to this article.

Seed

◀ 150 cell. That's the type most susceptible to breast cancer in humans. What if we took that differentiated, cancerous cell and, after making copies of it, tried maybe hundreds of different DNA manipulations of it? Isn't it possible that we could turn that cell back to its earliest divisions? To the beginning of its life, before it became cancerous? With the technique they worked out in Scotland, you can set the cells back to division zero. If we succeeded in doing that, we'd have a cure for cancer right now. Maybe this won't work, but you don't even think about these concepts until you seriously start thinking about the science of human cloning.

"And if you didn't get all the cancer cells the first time, you could conceivably repeat the treatment indefinitely. I can't see any side effects from this, certainly when compared with chemotherapy. If it worked, you could work on techniques for any cancer you could name — and, of course, AIDS.

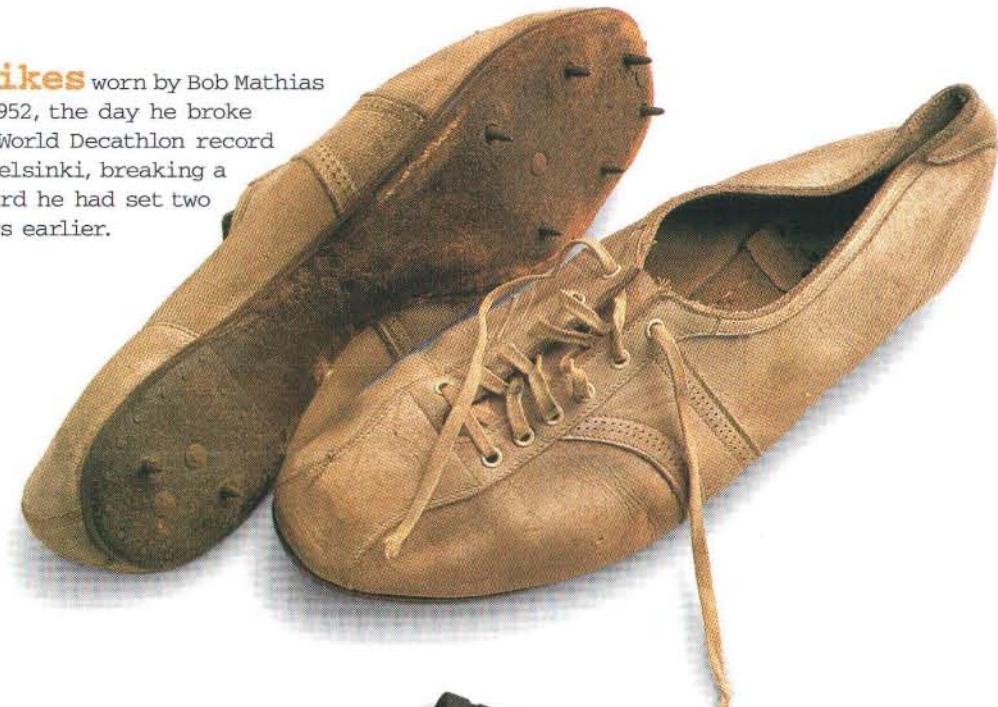
It's currently forbidden to use federal money to do human-embryo research; embryos are essential for this work. We'd like to fund it ourselves. But this type of experiment is so dramatic that the prohibition must be lifted for the kind of experiment I just described. It won't do any good to do these experiments in monkeys. You have to do them in humans. The technological and information benefits from human cloning will be far more significant than the cloning of humans itself.

I'm not saying I have any instructions from God to do this, but I am saying that it's the nature of Protestant thinking. People are dying every day, and they need sympathy. This is the pastor's role. But in the Protestant era, when anyone could read the Bible and think about it, Christians were able to read and think for themselves, without anyone between them and their idea of God. When we attain an extended life span and access to unlimited knowledge, we will become God-like. And that is God's intention. Some people think this idea is an excessive belief. My pastor is a little bit uncomfortable with my beliefs. He doesn't endorse my position — maybe he does 5 or 10 percent.

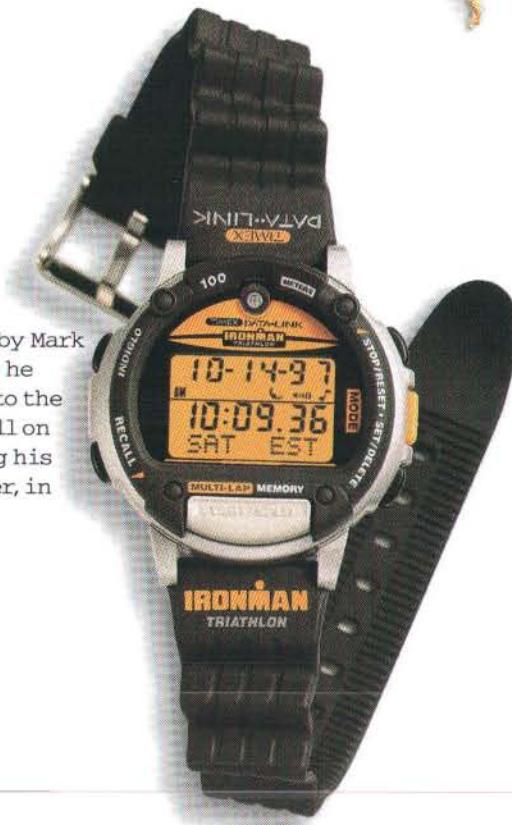
With an extended life span, I'd engage in the same human activities I've always engaged in. I'm not unhappy with what I've done in my life. I might be able to take on experiments that take longer to conclude — something that I know I won't be able to answer for 10, 20, or 30 years. I've tried retirement. Twice. Wow, boring.

Cloning is inevitable. If I don't do it, someone else will. There's no way you can stop science." ■ ■ ■

Spikes worn by Bob Mathias in 1952, the day he broke the World Decathlon record in Helsinki, breaking a record he had set two years earlier.



Watch worn by Mark Chesney the day he finally made it to the top of Devil's Hill on his bike, beating his black Lab, Boomer, in the process.



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Legion of Doom

◀ 158 quality level designers. To overshadow the poor imitations, id produced its own compendium called "The Doom Master Levels." The company recruited four celebrity *Doom* heads – Kvernmo, Anderson, Tim Willits, and Tom Mustaine.

This was the start of a Cambrian-like explosion in the professional evolution of the level designer. Until then, despite their professional-quality work, they were essentially consumers. They were humble. They dreamed of doing it for a living, but no one really believed it would happen to them.

To the contrary, all four would interview for their dream job: a full-time position at id.

The last time Kvernmo visited id Software, he recounts, he collided head-on "with greed." Carmack had just offered to hike his salary considerably if he jumped ship. Concentrating on dollar signs rather than stop signs, Kvernmo was broadsided by a sedan on his way home. He stayed with Ion Storm, but it wasn't an easy decision.

id is, after all, the place where it all began. Inside the black building – in suite 666 – resides a 14-strong team including the most highly regarded game developers in the world. Here sits John Carmack, pale, 27, dressed in a T-shirt and jeans.

The soft, carpeted offices are quieter than they used to be. In the game biz, the personality of

John Anderson, aka Dr Sleep, left a job at the Pennsylvania Department of Public Welfare to design *Daikatana's* classical Greek death arenas.

the dominant player in the group trickles down. At Ion Storm, Romero's troops impersonate their general – shouting words like "dumbass" and "hardcore." At id, it's quiet – coder quiet, Carmack quiet, key-tapping and hushed conversations. The words here are "sweet spot" and "ship date."

Carmack's not surprised that so many "amateurs" are being hired. It makes good business sense: fully trained mapmaking ninjas with years of experience, no previous salary to barter with, and a passion for their job. The talented people shine like beacons.

Accordingly, all the top Doom Babies have been courted by id. And a few years ago, they would

have blinded themselves for the chance. Says Anderson: "It seemed inconceivable that we would turn them down."

But only Tim Willits took the job. In 1995 he was at the University of Minnesota, studying computer science and business; he might have been the little guy you used to kick around at school.

Now payback means buying a 1997 Porsche with cash and plummeting you through six floors into a lava pit lined with nails. And then there's his office – nice furniture, comfy chairs, and two computers. This used to be Romero's office.

"I spent months working with Romero in here – picked his brain," says Willits, hired in '95 to shore up id's design team when things started to go pear-shaped during *Quake*'s development. Strife turned to acrimony after the game was released. Romero was fired. "He was a great guy, but a shitty manager," concludes Willits.

After Romero's departure, they took away the pool table and the foosball. Deathmatching was even banned in id's office during crunch time. The team was too busy knuckling down on *Quake II*.

"After *Quake II* we're washing our hands of it," explains Carmack. "We're on to other things. Let everyone else fight it out over content."

Those fights will feature, among other things, *Quake II*'s considerably ramped-up gore – the fine sprays of blood, the imploding walls of cartilage, and the airborne body parts that actually glisten. Yet Willits isn't worried, though they're his walls being splattered with ichor. For him, level designing is an underappreciated art form. He's molded frightening realism from the rawest of raw materials – triangles and pixels. "It's all about form, shape, and style rather than textures and walls, about conveying feeling to the player." He looks suddenly serious. "We're working with incredible technology here. And John's good. John's the pimp. There's no one like Carmack."

Except, maybe, Romero. Two generals, two camps, two sets of talented foot soldiers.

"There's some sniping about who's doing what and all that, and when people start treading on each other's release dates, then it gets a bit ugly," admits Carmack. "But even if Ion Storm is a spectacular success, we'll probably make more money than anyone there makes off it, because we've got a big chunk of the royalty."

Late at night, in the Ion Storm penthouse, the community has gathered to watch the Fourth of July fireworks.

Despite the rivalries, and the Romero-versus-Carmack thing, the Doom Babies still get along.

Even in this deranged city, they've maintained the sense of community from the CompuServe days. Then, they were united under a frontier mentality, working to push the open system to its limits. Now they get paid to compete.

Still, they share a vision borne by *Doom*.

And they see inspiration everywhere. Every book, film, and real-life Dallas landmark and eyesore is examined, mentally photocopied, and rendered in *Quake*-o-vision. A conversation between two Doom Babies goes something like this:

"Hey, look at that balcony."

"Yeah, nice ivy texture."

"What happens when it joins the wall there?"

"Nothing. It's seamless."

"Wow."

"You're standing in the bathroom, pissing," says a Doom Baby appropriately called Levelord. "You're looking at the wallpaper and you notice, on the corner, it doesn't line up. And you think, 'Couldn't they spend the time to line that up?' I do it in my levels."

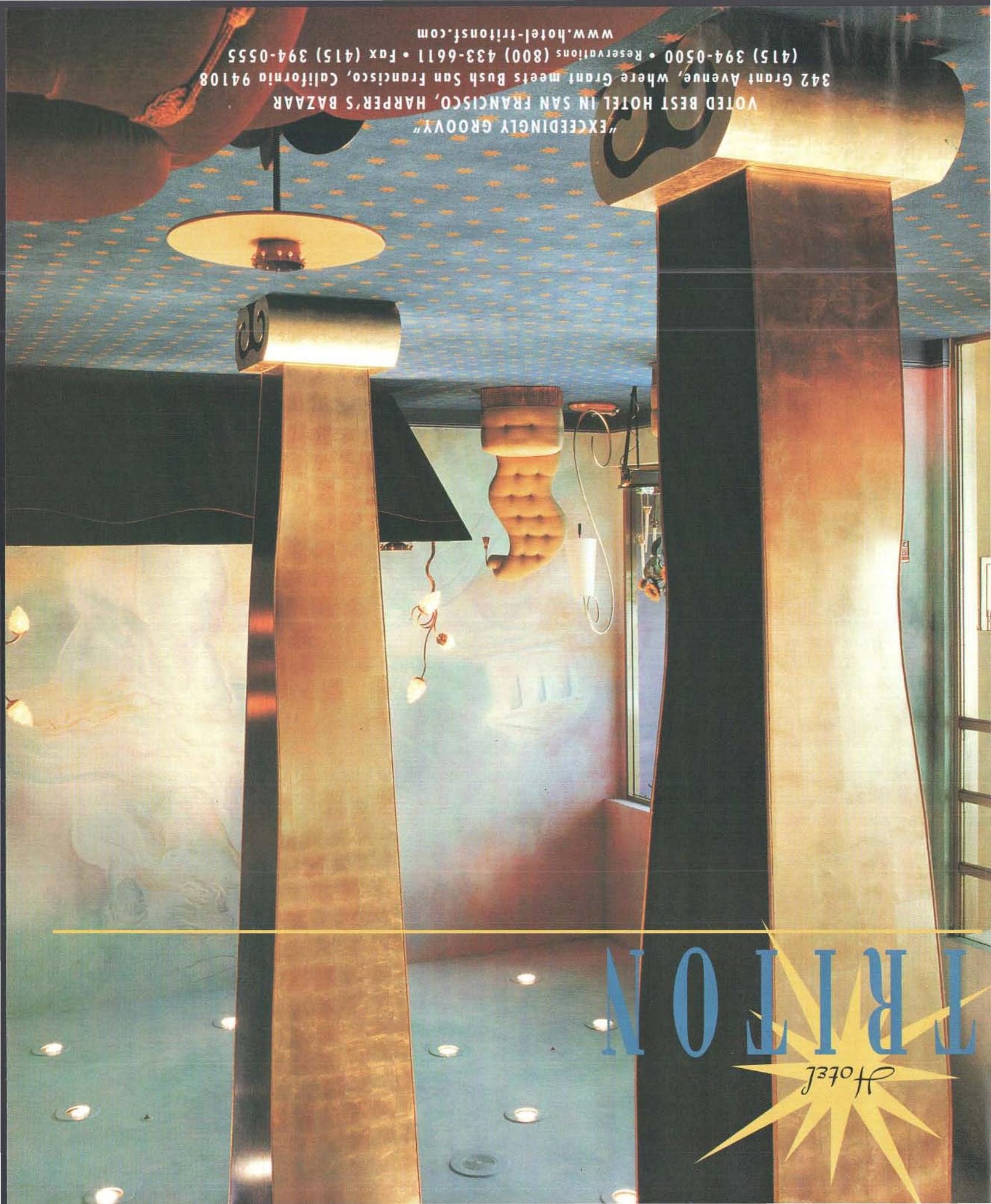
You can see why most of the Doom Babies spurned id. Romero is romantic, organic. Talent is the passport to his Game as Open System – your only résumé is your level, or your 3-D model, or your new evisceration animation. At id, things Carmackian are mechanical, planned, and meticulous. Productivity is the key to his Game as Machine. Sure, Carmack hits the *Quake II* Christmas deadline, while Romero watches *Daikatana* slip until April. But working at Ion Storm isn't a job, it's a daily visit to an amusement park.

id is unconcerned. Carmack is working on his next engine – code-named Trinity – which will bring even more realism to the desktop. He's unworried by rival technology. First-class developers like Epic MegaGames and 3D Realms are working on next-generation front ends. Even Microsoft, it seems, is hankering to muscle in on the open-game posse with the DirectEngine, which was coded by Monolith Productions.

"They're all a year behind," Carmack says, adding with a hint of uncharacteristic sarcasm, "and like, I'm supposed to be scared of Monolith."

Atop Ion Storm, you have to squint to see the fireworks flare on the horizon. It seems the Commerce Tower is too tall, too high in the clouds. Disappointed, the crew departs to play a deathmatch, leaving only the security guard on the roof. Asked if he plays *Quake*, the guard chuckles, "I don't need to. I've got 70 handguns and 150 rifles. I'm mad."

Crazy place, Dallas. ■ ■ ■



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T R I T O N

Hack the Magic

◀ 168 One thing Disney can't control is the weather – which is not to say that it doesn't scrutinize the skies over Orlando as carefully as any air traffic control center. One Central Console screen shows a radar image of the property, as well as current data about wind speed, temperature, and rainfall. Says Blackwell: "We keep an eye on the weather in case we need to cancel outdoor shows or shut down certain attractions like the Skyway," a gondola that runs between Fantasyland and Tomorrowland. "The decisionmaking is guest oriented," he goes on. "We want to keep things operating as long as we can."

Blackwell, who began his career at the Magic Kingdom as a 15-year-old balloon vendor on Main Street nearly a quarter century ago, explains that there's a merchandising consideration, too: the weather station allows the Central Console to warn the dozens of shops around the park so they can set out Mickey umbrellas and bright yellow ponchos before the first raindrop falls. As he talks, it becomes clear that the Disney "cast member" structure is a case study in the networked system. Though Blackwell's bailiwick is engineering, he takes pains to point out earnestly that "shelf space is very valuable – it wouldn't make sense to have rain gear out on a sunny day."

Weather is similarly on the minds of a crew of horticulturists, stationed in a nondescript bungalow south of the Magic Kingdom, who are responsible for keeping 3,500 acres of impossibly lush landscaping looking that way. "Landscaping is very important to the show," Scott Shultz, a horticulture area manager, tells me, adding in the same tone of earnestness that guests would have a hard time believing they were steaming down the Amazon without a suitable rain forest or strolling along Hollywood Boulevard without towering palm trees.

Shultz and two other horticulturists operate MaxiCom, a computerized irrigation system made by Rain Bird. Based on input from the weather stations, MaxiCom's PC-based software determines how much water each of the property's 600 zones needs. Each has up to 10 individually watered beds; when a message comes in from the gardeners that a row of azaleas at Disney-MGM Studios is drying out, the horticulturist will increase the amount of water delivered there each night. When a torrential rainstorm passes over the property, the MaxiCom system adjusts by watering less – about 50 automated rain cans

that measure by hundredths of an inch are scattered around the property and plugged into the network. "Every morning at 1:25, we download the data to cluster control units (CCUs) situated around the property," says Shultz. The CCUs manage the sprinkler timers, which govern 50,000 sprinkler heads between them. Shultz's crew also prowls the property daily in a van equipped with a laptop and cellular modem, troubleshooting the whole system – one of the most sophisticated large-scale irrigation setups anywhere.

Then there's the Muzak.

Back in Engineering Central, a rack of Sony CD players handles background music for the Kingdom, keyed to the six different Lands, as well as to different times of day. The music – hillbilly banjo picking for Frontierland, for example – travels via dedicated lines to weatherproof speakers hidden throughout the park. But first it's filtered through a sophisticated switcher-router system that lets Disney's programmers create "events" – or miniature programs – that fade the music in or out as necessary.

Engineering Central's Crown IQ computerized sound system also controls overall audio volume throughout the park. "People absorb noise, and they create noise of their own," Blackwell notes. "As the crowds come in through Main Street and the morning progresses, we subtly increase the sound of the background music so it doesn't get drowned out."

Across the room from where we're sitting is a cramped, closet-sized space that looks like a cross between a recording studio and a surveillance bunker – Parade Central. Inside, a colorful map of the park fills one monitor; another has a bird's-eye video view down Main Street from the top of Cinderella Castle. A huge mixing board dominates the desk, where a single technician orchestrates the twice-daily parades that are a Magic Kingdom staple.

Audio specialist Jim Dotson sits down and starts an imaginary parade. "We fire the event by phone," he says, loading the parade data into the system from a Digital Equipment VAX mainframe. "As the parade progresses, the audio cross-fades from zone to zone. So you hear different music based on where you're sitting and what float is in front of you."

It's a major feat of synchronization, and easier said than done. To make the music from speakers on the floats match the music from 175 speakers along the parade route, the first thing the system needs to know is the minute-to-minute location of the floats. It gets that from "pucks" embedded

in the street that communicate with each vehicle; each float also signals its precise location by counting the number of wheel revolutions it makes. Parade Central's monitors show tiny, color-coded float icons inching through the park: red if things are moving too fast, green for too slow, and gray for normal. When an icon turns black, that's a bad sign. It means a float has gotten stuck in, say, the trolley tracks that line Main Street. A tractor – waiting on standby, of course – is dispatched by radio to make the rescue.

The audio track itself is separately stored on each float, using NuOptics EPROM-embedded chips. The route is divided into 33 separate zones, with the playback coordinated by a DTMF (dual-tone modulation frequency) code broadcast from the top of Cinderella Castle. "That makes sure that the cross-fades are hitting at the right time as floats move from zone to zone," Dotson says.

On a lot of vehicles – say, the Little Mermaid float, which features Sebastian the crab singing, talking, and waving his arms – the audio also has to be synced with the character. The answer: SMPTE time codes – the same Society of Motion Picture of Television Engineers codes used to match up images and sound in TV and movie production. Here they control not just the music and animatronics, but also, indirectly, the float drivers and performers.

And what about, say, midparade downpours, a regular occurrence during summer afternoons in central Florida? "We just click an icon, and the parade bypasses all its production numbers and just goes straight from point A to point B," says Dotson. "We try to avoid water damage to the costumes and floats."

Even software sprinkled with pixie dust can get buggy. Not long ago, Parade Central's monitors showed some floats speeding up and passing others in midprocession, which definitely was not happening on the ground. "We had a meeting to debug it," Dotson explains, "and we figured out that in the staging area where the floats line up, just behind Town Hall on Main Street, some of the drivers would park their floats out of order. Then, when the parade was ready to start, they'd move around and get into position. All the while, the VAX was reading the wheel rotations, and the extra revs meant the second float was way ahead of the first. We had to scour the logs to figure out what was going on and take care of it."

As he's talking, Smith's and Blackwell's beepers go off. (The pagers are, of course, emblazoned

with Mickey Mouse icons; both the paging and telephone system are run by Disney's own Vista-United Telecommunications.) Smith looks down at the alphanumeric display. "Curtain's broken at Bear Band" – shorthand for Frontierland's Country Bear Jamboree. The notice is just a formality – technicians from Attractions West (one of several administrative zones in the Magic Kingdom) have already been dispatched to the scene. During the day, two dozen maintenance people make sure all the shows stay 102 (online). At night, when the bulk of maintenance and upkeep is done, the staffing jumps to 85.

Blackwell and I head out through the broken biometric door and down the Utilidor toward Tomorrowland. "The day shift and second shift are focused on keeping the attractions running and the guests safe," he says. "At night, we address show quality and do inspections and adjust the animation. So, during the day, in spurts, it's fast and furious – responding to emergencies. At night, it's routine maintenance." The PA in the tunnel is playing Bachman-Turner Overdrive's "Takin' Care of Business"; no "Whistle While You Work" for this crew.

The story line of Alien Encounter, which debuted as part of a revamped Tomorrowland in 1995, is one of Disney's old standards: technology gone awry. The conceit is that a new teleportation device, developed by the Orwellian XS Tech Corporation, is being demo'd for the audience. In the preshow area, it accidentally sizzles over a lovable, fuzzy alien. Inside the auditorium, it misfires again, beaming down a drooling carnivore (audio-animatronic, actually) instead of the glad-handing CEO of XS Tech. The teleportation device fails once more before the show is over; it can't contain the hungry alien, who breaks out and begins feasting on the assembled crowd.

In the service area below, the story is dramatically different: here, the technology is safe, controlled, and utterly predictable. For starters, there are several banks of 1,800-watt-per-channel servo-driven subwoofers that produce a low-frequency audio rumble. There are also transducers on the seats, which periodically cause everything upstairs that's not bolted down to vibrate in sympathy with the faux alien. Jimmy Sizemore and Mike Jones, the technicians who keep tabs on the show, seem to tune it out. They've got bulky ear protectors handy – the kind airport ground crews wear – in case they have to enter the subwoofer dungeon when a

show's in progress. They won't let me into the room when the monster woofers are in action. But the din – even through a set of heavy metal doors – sounds like an AC/DC concert without the treble.

Despite the noise, it would be hard, based on what goes on down here, to imagine what kind of pulse-pounding theatrical experience is going on upstairs. Sizemore and Jones spend their shift taking care of the gear, making sure the attrac-

Universal Studios). But the engineering ethos isn't about the coolest, newest technologies; indeed, older shows like The American Adventure still run on mag tape, a decades-old platform. This is showbiz, not science; reliability counts for a lot. And the company keeps a close eye on costs, normally replacing major systems only when an entire attraction is closing down anyway for rehab.

Alien Encounter, which replaced Mission to

There are enough computers to run an online service, manage a multinational bank, or put on a 21-minute show for a herd of tourists.

tion stays 102. A lanky Tennessean who used to work in construction, Sizemore says simply, "Nothing can really prepare you for this kind of job."

It includes keeping an eye on the 8-foot-long Coherent Innova laser outfit that creates many of the futuristic lighting effects of Alien Encounter. The rig requires regular recalibration, since the minor earthquake created by the transducers continually throws it out of alignment. Other routine tasks include checking for leaks in the hydraulic pumps and pipelines that supply fluid to the show's animatronic figures and lifts. There's also a lighting system fit for Pink Floyd, run by Omega Show Controllers, that sends rapid-fire cues to a set of Intellibeam controllers that operate programmable spotlights. And finally, there's baby-sitting enough computers to run a major online service, support a good-sized television network, manage a multinational bank, or, well, put on a 21-minute show for a herd of tourists.

The 7-foot racks of computer gear include a mélange of expensive silicon that Disney's design arm, Imagineering, creates with the help of MAPO, its manufacturing group. (The latter's name is a play on "Mary Poppins," intended to evoke the whimsy that Disney's technology strives to generate.)

Blackwell, Long, and the others are squirmly when it comes to distinguishing between what Disney makes and what comes from outside vendors. But it's clear from the brand names on some of the equipment that, as Eric Jacobson, senior vice president of creative development at Imagineering, puts it, the company doesn't feel the need to "constantly reinvent the wheel." Disney's audio-animatronic figures set the standard for the industry (which includes rivals like

Mars, is part of the new generation. It's built around what Disney calls a show-supervisor unit – an SSU, to the people who run it – a rack-mounted system that coordinates lighting, smoke effects, audio, and video screens. The machine also manages three SIUs – show-interface units – one that controls the brief preshow and one for each of the two side-by-side sit-down theaters. There are EPROMs to store digital audio, as well as MAPO-designed MFSCs (multifeedback servo cards), each of which can control up to eight functions on an animatronic figure. The whole performance is synchronized using SMPTE generators from Gray Engineering Labs; programmable logic controllers monitor various functions for failure. Backstage, Disney prefers that its technology not go awry.

Disney may be classified by stock analysts as an entertainment company, but it has been hovering around technology from the start, 70 years ago: sound married to animation in *Steamboat Willie*, new camera setups invented for *Fantasia*, the most sophisticated robot built to date (a faux Abe Lincoln) for the 1964 New York World's Fair.

That said, Disney is decidedly not into releasing bug-ridden beta versions, a policy that becomes clear on a visit to Test Track, the General Motors-sponsored Epcot thrill ride that was supposed to open to the public in the spring of last year. It's now expected to open in time for this summer's crowds.

Development on this ride is exhaustive and expensive. That's classic Walt. According to Bob Thomas's 1976 biography, *Walt Disney: An American Original*, Disney told one of the original 188 ►

Hack the Magic

◀ 187 Imagineers, "You and I don't worry about whether anything is cheap or expensive. We only worry if it's good. I have a theory that if it's good enough, the public will pay you back for it. I've got a big building full of all kinds of guys who worry about costs and money. You and I just worry about doing a good show."

The Test Track concept is a bit daunting: guests serve as crash-test dummies in a high-speed reenactment of automobile safety and perfor-

so fast – zip, snap, like a camera shutter – that it takes us a few cycles to realize that outside the doors, it's pouring rain. During this part of the ride, the vehicle will appear to be performing a collision test with the wall, speeding up and then – seemingly – bashing right into a barrier. In reality the vehicle will slip through the door so quickly, accompanied by dramatic audio and visual effects, that riders will think they actually busted through the wall.

A technician is sitting in a folding chair near the doors, reading a copy of *USA Today* and wait-

the ride is problem-free and ready to run, they'll summon groups of cast members from around the property to be guinea pigs. Then they'll do a "soft" opening, allowing guests to ride for a few hours a day. That gives engineers a chance to make any final adjustments – and attendants to become proficient at loading the vehicles with their human cargo.

What the "guests" get – and, by all accounts, are subliminally attracted to – is an environment where nothing is left to chance.

mance tests. No one will talk about why the débüt is so far behind schedule, but rumors variously have it that the tires are wearing out too quickly, the track needs more control zones, or the Imagineers keep adding new flourishes. Getting a show like Test Track ready involves running various components nonstop until glitches emerge. On the upper level of the ride, there's a set of sliding doors that open and close

ing to see whether anything breaks. Every 10.5 seconds the doors open – zip, snap. Says project engineer Jerold Kaplan: "You can't just walk out to Joe's Fast-Operating Door Warehouse and find doors that open in half a second – at least that we know of. So we built this ourselves, and that means that we need to test it for reliability ourselves." The doors seem to be working fine so far.

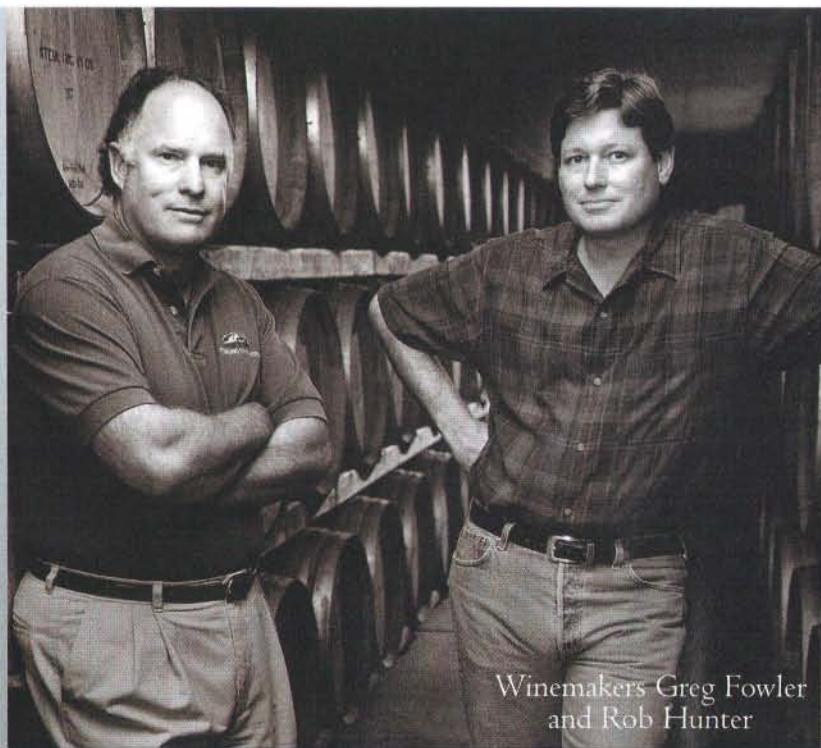
Once Kaplan and his crew are convinced that

it's hard to imagine a more problem-free piece of the planet than Walt Disney World. A massive fleet of monorails, buses, ferry boats, and trams transport 150,000 people to and from the three major parks on a busy day. Each entrant is sold a magnetically coded piece of paper (to register with a networked turnstile), then fed, entertained, corralled, bombarded with experiences, and sold merchandise (the average daily spending per visitor is \$52). When Disney asks its guests about the quality of their experience, fewer than 2 percent rate it "below average."

What guests get, and by all accounts are subliminally attracted to, is an environment where nothing is left to chance. The fact that Disney exercises just as much control over its guests as its hardware is turned to advantage – not least

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because this coercion is as invisible as the computer terminals themselves. In all three Florida parks, for example, there's a camera shop on the right as you enter in the morning ("Hey, we need to get some film!") and souvenir shops on the right as you exit at the end of the day ("Hey, let's get a Pluto T-shirt for the dog-sitter!"). The placement of these shops is decidedly not arbitrary; park designers operate on the principle that most people are right-handed and thus favor that side as they walk. The most popular rides, meanwhile, are located at the park perimeters for the same reason that supermarkets stock milk in the back of the store: people will buy food and souvenirs along the way, as well as try other rides, further filling Disney's coffers and spreading out the crowds.

But Disney planners are wary of making things too efficient. The right amount of waiting in line helps build anticipation, whether for a spin with Dumbo the Flying Elephant or a 13-story near-freefall drop in the Twilight Zone Tower of Terror. And if guests could flit easily from ride to ride, they'd be done with a park around lunchtime. The longer they stay, the more they spend (an estimated \$5 billion overall in 1997). The most valuable visitors are those who stay in one of the

parks' 26 Disney-owned hotels. The company lets them into the parks an hour early. It also schedules parades for midafternoon, when people might be tempted to head back to their hotel for a swim or a nap. And it seduces tired families into lingering past dark with spectacular fireworks displays.

The fireworks show at Epcot uses 26 computers that control music, strobes, lasers, fountains, and the ignition of 750 aerial shells, candles, comets, and mines. Like parades at the Magic Kingdom, everything is synchronized using the SMPTE time code, ensuring that the CD players in a room beneath Future World sync up with the independent lighting computers at each of World Showcase's 11 pavilions, not to mention the four launching barges that float in the lagoon.

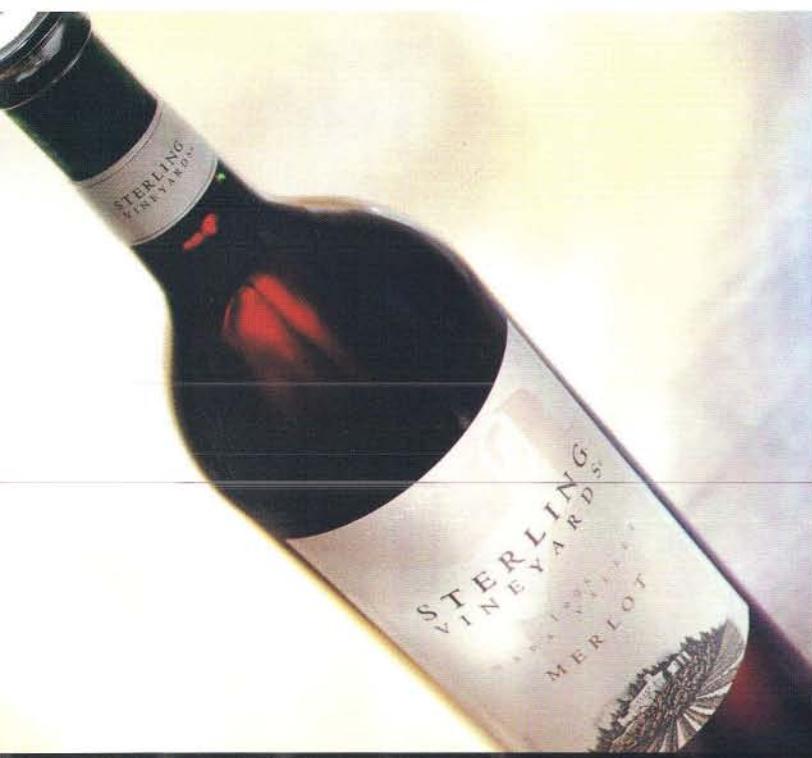
"We call it a kiss goodnight," says fireworks production manager Bernie Durgin.

Atop the Mexico pavilion, a team of technicians monitors the show, keeping an eye on the weather radar. If the winds in the area exceed 20 miles per hour, they'll load a different version of the show into the computers — one that eliminates some of the high-flying shells. They're also on the lookout for low-flying aircraft, in which

case they turn some of the lasers off. As with the rest of Disney's attractions, cast members like Durgin do frequent show-quality reviews to make sure the pyrotechnics are up to par.

Disney is also doing some pushing on the pyrotechnic front — Durgin's group is looking into building microprocessors into the shells to control their detonation postlaunch, with just a 10-millisecond margin of error. "If you were able to synchronize the music and the pyrotechnics, you could create some interesting effects," he says excitedly. But then, lest I get the wrong idea, he hastens to add that this is not technology for technology's sake. "The idea is to be able to create and evoke feelings and emotions within an audience," he assures me.

The funny thing is, I actually believe him, even after I've ventured into the illusionists' private quarters and have their trade secrets revealed. Something strange is going on at Walt Disney World: technology has transcended the actuators and SSUs and multifeedback servo cards. The hardware and software have dissolved into the background, like the Cheshire cat. What remains is a virtual world — illusions on top of technology. And as advanced as the gadgetry gets, it's still the magic that draws us in. ■ ■ ■



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complexity. No wonder the people at Sterling make wines of such character.

Gravity

◀ 177 hopeless muddle of wacky ideas and grandiose claims, but on its back cover it reproduced an announcement from the Office of Technology Transfer at the University of South Carolina.

Incredibly, this text described a "gravity generator" that would create a *force beam* in any desired direction. The announcement concluded: "University seeks licensee and/or joint development. USC ID number: 96140." At the bottom of the page was a phone number for William F. Littlejohn at the Office of Technology Transfer, so I called it, and reached an assistant named Frances Jones. Sounding not very happy, she confirmed that the announcement was genuine. "But Mr. Littlejohn says it was presented prematurely, it got wider distribution than we intended, and we're - still working on the technology, and would prefer not to receive any publicity."

1990), and he even managed to get a US patent for his device (number 5,280,864, issued January 25, 1994).

I called him at his office at Cal State Fullerton, where he's been affiliated for 25 years and is currently an adjunct professor of physics. He turned out to be a jovial, amiable man who was more than willing to talk on the record, probably because his work has remained so obscure, no one has had a chance to ridicule it yet.

The equipment he uses is relatively simple, which is just as well, since he's had to pay for a lot of it himself. If you want to reduce the mass of an object in the privacy of your own basement workshop, here's how it's done: Obtain a high tech ceramic capacitor (a standard electronic item) and attach it to the speaker terminals on a stereo amplifier. Feed in a steady tone (perhaps from one of those stereo-test CDs) while using some kind of electromechanical apparatus (maybe the guts from an old loudspeaker) to vibrate

you could have something within three to five years. For spacecraft, all you'd need would be big solar arrays instead of rocket fuel."

I asked him if there was any chance that his discovery might turn out to be bogus, like cold fusion. "Of course!" he said, laughing cheerfully. "I have biweekly paranoia attacks, and then I try something else to see if I can make this effect go away. But, it won't go away."

I asked his opinion of the team at NASA. "Serious and competent, sensible folks," he said - though he seemed to find gravity shielding a bit implausible, even compared with mass reduction.

Clearly, it was time to call NASA. I contacted David Noever, a theoretical physicist and former Rhodes scholar who started working with NASA in 1987 after getting a PhD at Oxford University, England. He seemed to be the key figure trying to replicate Podkletnov's work, and he invited me to see for myself.

T

he Marshall Spaceflight Center is a box-shaped 10-story office building with a 1960s pedigree. The closer I came, the shabbier it looked; when I walked up the front steps, I noticed cracks between the faded gray panels of its facade. Alas, poor NASA! Formerly the favorite child of federal legislators, now nickel-and-dimed half to death. Upstairs I found utilitarian government-style offices with cheesy rubberized floor tiles, ancient gray steel desks, and file cabinets that seemed to have been repainted by hand. The place was almost Soviet in its austerity.

I entered the office of Whitt Brantley, chief of the Advanced Concepts Office, and found five people waiting around a wood-grain formica conference table. David Noever was one of them: a tall, brooding figure with intense eyes and dark brown hair in need of a trim. Behind a desk at the far end sat Brantley, a genial Santa Claus who joined NASA back in 1963, when he worked on von Braun's wildly ambitious scheme to put men on Mars, before the Apollo program had even test-launched its first capsule. Even this seemed relatively normal, though, compared with gravity shielding. I asked him how he had raised the money for such a wacky idea.

Practical applications of mass reduction

could be within five years, says James Woodward - "if someone decided to put in substantial amounts of money."

She refused to say if Douglas Torr was involved, but on the university's Web site I found an Annual Report to the Faculty Senate which listed his name on a patent application for the gravity generator. This was totally bizarre; a respected university supposedly looking for commercial partners to develop a gadget straight out of a 1950s science-fiction novel. Surely, nothing could be weirder than this - but no, there was more in store. Through my physicist friend John Cramer I learned of a scientist named James Woodward who claimed to have found a way to reduce the *mass* of objects.

"Mass" doesn't mean the same thing as "weight." You'd weigh less on the moon than on the Earth, because weight depends on the force of gravity. Mass, on the other hand, is an innate property of matter; it exists even when an object is in free fall. Nevertheless, Woodward had written a paper claiming that he could adjust the mass of an object (*Foundations of Physics Letters*, vol. 3, no. 5,

the capacitor up and down. According to Woodward, the capacitor's mass will vary at twice the frequency of the signal, so you will need a circuit called a frequency doubler to drive your vibrator at the correct rate. If the vibrator lifts the capacitor while it's momentarily lighter and drops it while it's heavier, you achieve an average mass reduction - which sounds as if you're getting something for nothing, except that Woodward believes that in some mysterious fashion you are actually stealing the energy from the rest of the universe.

I asked him why no one had ever noticed that the weight of capacitors varies in rhythm with their energy level. "Well," he said, "people don't normally go around weighing capacitors."

He claimed that so far he's measured a reduction of up to 150 milligrams; just a fraction of an ounce. Still, practical applications could be developed. "If someone decided to put substantial amounts of money into this,

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Gravity

◀ 190 “The first research proposal I wrote didn’t have the word ‘gravity’ in it anywhere,” he said with a grin. “Then the *Sunday Telegraph* article came out, and our administrator, Goldin, was going to a *Star Trek* convention where the Trekkies might ask him about gravity modification, so we decided to tell him what was going on. He backed up a step or two, then said he thought NASA should spend a *little* money on work like this. So, we wiped the sweat off our brows and continued.”

Tony Robertson, another member of the team, leaned forward, a lot younger and more earnest than Brantley. “The way I see it,” he said, “NASA has a *responsibility* to overcome gravity.”

“Right,” said Brantley. “We’ve been building antigravity machines since day one – it’s just that they’re not as efficient as we’d like them to be.”

Everyone chuckled at that.

“It’s true we’re pushing the edge,” Brantley went on. “But the only way to guarantee you don’t win the lottery is, don’t buy a ticket.”

I turned to David Noever, who looked tense and restless, as if he’d rather be in his laboratory. I asked how he felt about amateur gravity enthusiasts. “Well, we went to visit John Schnurer,” he said. “But he wouldn’t let us in. We had to meet him outside on a park bench. We also invited Podkletnov to come to Huntsville, back in January 1997. We said we’d pay his way, but he said he didn’t see any value in it.”

“It’s not uncommon for people to distrust NASA,” said Brantley, “because we’re part of the government. They think even if we did discover something, we’d cover it up. You know, Roswell and all that –”

By this time, Noever was definitely ready to go. “Let’s show you the lab,” he said.

He led the way outside to an enclave of austere, ugly concrete buildings that looked as if they might have been left over from World War II. Inside, past massive machinery for pressing ceramic discs, I entered a lab about 20 feet square, with one wall of windows, fluorescent ceiling panels, big white cylinders of liquid helium and liquid nitrogen, and heavy-duty rack-mounted power supplies in rectangular metal cabinets.

Noever explained that the team is trying

several different approaches. He showed an assortment of 1-inch superconducting discs, made from every conceivable mix of ingredients. He demonstrated a gravimeter: a beige-painted metal unit the size of a car battery. Across the room was a tall insulated tank about a foot in diameter, with a huge coil wrapped around the base capable of taking 800 amps, though Noever said that the current would create enough heat to melt the floor. The tank had been designed to contain a 6-inch disc rotating in liquid helium, with the gravimeter suspended above.

Meanwhile, the team was still struggling to fabricate 12-inch discs, which tend to fracture into pieces during pressing and a subsequent baking process. “This is what Podkletnov says is the heart of the matter,” said Noever, “learning to make the discs. He said it could take us one or two years. He did reveal the composition –”

But not the step-by-step method for production?

Noever laughed sourly. “Of course not. At least, he hasn’t told *us*. He’s very adamant about not talking to people about some aspects of this work.”

Already, though, Noever said he had achieved some possible results with smaller discs. He showed one graph that suggested significant changes in gravitational force. “We only saw this a couple of times. We have to see it 100 times before we’ll allow ourselves to reach any conclusions. And then we’ll get the Bureau of Standards in here to check it out, and then, maybe, we’ll publish a paper.”

Noever suggested that gravity may have a natural frequency, far higher than X rays or microwaves, which would explain why it penetrates all known materials. A superconducting disc could resonate and downshift the frequency to a lower level where it could be blocked by normal matter. “But this is all very speculative,” he cautioned, adding that it’s just one of three theories that could explain gravity shielding.

Ron Koczor, project manager of the team, had been sitting over at one side of the lab looking amiable but diffident. Koczor’s background is in infrared and visible optics; his last project was a space shuttle experiment to measure winds in Earth’s atmosphere using specially designed lasers. By comparison, gravity shielding research is a labyrinth of uncertainties.

“In this kind of research you go from depression to elation, sometimes just from hour to hour,” said Koczor. “But if this is real, it’s going to change civilization. The payoff boggles the mind. Theories about gravitational force today are probably comparable to knowledge of electromagnetism a century ago. If you think what electricity has done for us since then, you see what controlling gravity might do for us in the future.”

B

efore going to Huntsville I had sent yet another message to Giovanni Modanese, asking again if Eugene Podkletnov was willing to talk to me. Naturally I didn’t expect a positive reply – but to my amazement Modanese wrote back saying that Podkletnov had returned to Finland and was now ready to cooperate.

I called Podkletnov right away. Yes, he said, it was true; he would talk. I could meet him in person.

Four days later I was boarding a Finnair MD-11. Nine hours after that I found myself in Helsinki Airport, waiting for my baggage to come off a carousel. About 200 Finns were waiting with me, looking stoic and withdrawn, like guests at a funeral. The only sound was the clanking of the conveyor belt, and I remembered a phrase from the *Lonely Planet* travel guide that I’d read on the plane: “A happy, talkative Finn does not inspire admiration among fellow Finns, but rather animosity, jealousy, or hostility. Being silent is the way to go.”

Outside, it was almost noon but looked like dusk. “Winter is the most hopeless time, when many people are depressed,” my guidebook warned me. In fact, back in the early 1970s a Finnish scientist named Erkki Vaisanen discovered SAD – seasonal affective disorder, the type of depression caused by lack of sunlight. He was tipped off by the rash of suicides that sweeps through Finland every September. I began to wonder why Podkletnov had chosen to relocate here.

I drove to a grim little industrial park (where all the buildings were painted gray, as if to emulate the weather) and checked in at a Holiday Inn that looked like a 194 ►

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Gravity

◀ 192 small electronics factory. After exiting an elevator paneled in stainless steel, I struggled to open a massive metal fire door, walked past a sauna, and unlocked my tiny Euro-style room. Shortly before sunset, around 4:30 in the afternoon, I did some serious channel surfing in a dutiful attempt to locate and comprehend the core, the quintessence of Finland.

The first thing I found was an ancient episode of *hey-hey-we're-the-Monkees* resuscitated from some godforsaken video archive and dubbed in French, "*parce que nous* monkee around." Then there was a 1990 Hong Kong action movie, dubbed in German, subtitled in Finnish – maybe Swedish, it was hard to tell.

Finland's identity was proving elusive, and I could think of at least one reason why. A key factor could be the 1,300-kilometer frontier that the country shares with Russia.

A

nd so, finally: Tampere.

As I drive in on Highway 3, the first thing I see is a huge smokestack and a rail yard with mercury-vapor lights on steel towers. Another smokestack stands in the distance, trailing a white plume. Although the population is under 200,000, this is still the second-largest city in Finland, and a haven for industry.

Opposite the railroad I find the Hotel Arctia, where Podkletnov has agreed to meet, since he feels that his "modest apartment building" is not suitable.

In a slightly rundown lobby paneled in varnished plywood, I sit on a couch upholstered in drab gray wrinkled fabric and wait as patiently as I can, very conscious that I have come 5,000 miles on this far-fetched, far-flung pilgrimage – at which point a man in a navy blue pinstriped business suit walks into the lobby.

with the Sheffield students, and he went in person to Canada, where he stayed for several weeks. "If people follow my experiments exactly," he says, "they succeed. But if they want to follow their own way –" He shrugs. "I try to cheer them up, let them do it, they may find things that I missed." He sounds skeptical – sarcastic, even – and I think he's referring to the NASA team. I wonder if there's a trace of Russian jealousy, here; a suspicion that well-funded Americans will stamp "NASA" on the side of the first fully functional grav-modifying flying machine, at which point everyone will forget about Eugene Podkletnov.

He claims, though, he's happy to share the glory. "What we should do is combine our efforts and organize the Institute for Gravity Research. My aim in life is not to get money, not to become famous. I have 30 publications in materials science, and 10 patents, but –" His mouth twists with bittersweet humor. "Russian people are never rich unless they are criminals. I don't dream about big money. I just want a normal existence, working for the Institute for Gravity Research. That is my dream."

He speaks rapidly and shows no hesitation, not the slightest sign of doubt. I get him to stop and back up a little, to tell me about his history.

He says that his father was a materials scientist, while his mother had a PhD in medicine – just as he, now, is a materials scientist with a wife who is studying medicine. "My father was born in 1896, he spoke six languages freely, he became a professor at Saint Petersburg, we had the atmosphere of scientific research at home all the time. I was brought up surrounded by adults, spent very little time playing with friends in school, and even now I feel different from colleagues my own age. My father had several inventions in his life, but at that time the Russians asked him like this: 'Does this method exist in the United States?' My father answered no, so they said, 'Then this must be entire nonsense.'" Again Podkletnov gives me an ambiguous smile, tainted with bitterness. "Finally when he got a patent in the United States and Japan, then they gave him a patent in Russia."

Eugene graduated with a master's degree from the University of Chemical Technology, Mendeleyev Institute, in Moscow; then 196 ▶

Gravity may have a natural frequency.

says NASA's David Noever, far higher than X rays or microwaves –

which would explain why it penetrates all known materials.

How did the Finns cope with the ominous presence of that notoriously expansionist superpower during the fearful decades of the Cold War? They suppressed their separate national identity. They made their political system close enough to communism to placate the Politburo, and they traded actively, selling the Russians cheap wood products and electronic devices such as telephones. Thus, they made themselves far too useful to be worth invading.

Interestingly, the policy of appeasement paid dividends. Finland enjoys steady growth, with inflation down near 1 percent. It exports telecommunications products to the rest of Europe and steals shipbuilding contracts from the Japanese. Its infrastructure looks well maintained. Its people seem healthy. Thus, Eugene Podkletnov's presence here is not such a mystery after all. Compared with Russia, Finland is a land of opportunity.

This is Eugene Podkletnov.

He looks strangely similar to NASA scientist David Noever, with sharp features and a restless intensity. Close up, though, his face shows a poignant mix of emotions. His mouth twists quixotically at the corners, as if, at any moment, he may display some unexpected response – pathos, laughter, or resignation.

He sits beside me on the rumpled gray couch, and I ask why he decided to talk to me after almost a year of evasion. "You seem sincere," he says, choosing his words cautiously, "and you are polite, and –" He smiles faintly. "You are very persistent."

But he's not interested in small talk. He pulls out a wad of papers and starts a long monolog.

First, he tells me, his work has been replicated by students in Sheffield, England, and scientists in Toronto, Canada. No, he won't give me their names. He consulted by phone

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I really enjoyed & learned! **TEDMED** helped enhance my understanding of consumer health trends. If there's a **TEDMED2** count me among the participants.

Gilbert Bashe • Executive VP Hill & Knowlton

Richard Wurman in the **TEDMED** conference holistically approaches all aspects of the healthcare industry – his conference challenged, inspired & excited me – I had a great time!

Daniel Biondi • Senior VP Olympus America

You do an extraordinary job of organizing conferences & bringing stimulating issues & people to bear on ideas which I wouldn't necessarily call topical, but let's say rather, critical. I've chosen in recent years to avoid conferences because so little new is discussed, but clearly, this was the exception & I'm glad I made it.

Rick Carlson • President & CEO AgeWave Health Services

[**TEDMED**] was an overwhelming success. I definitely think you should do it again.

Horace Deets • Executive Director AARP

As I reflect on those two days, the experience seems like opening an enormous box of chocolates which I ate too quickly. I hope that as I gradually absorb what I saw & learned that I will retain my now-vivid sense of being uplifted, enhanced & encouraged.

Joan Dunlop • President International Women's Health Coalition

What a great conference! The best & most informative I have ever attended. The half hour format, the excellence of the speakers, the choice of topics & the fine attention to detail by all the staff set exactly the right stage for the impresario.

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What a fantastic two days! Thank you. Please do it again.

I'm sure I can get at least ten people to go!

Linda Holliday • President Medical Broadcasting

I think, on balance, that [**TEDMED**] came off & that most people felt it was a time of information, excitement, & positive planning for the future. There is a lot of activity in high-tech communication & the development of the health information infrastructure.

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Gravity

◀ 194 spent 15 years at the Institute for High Temperatures in the Russian Academy of Sciences. In 1988 Tampere University's Institute of Technology invited him to pursue a PhD in the manufacture of superconductors, and after he obtained his doctorate, he continued working there – until the *Sunday Telegraph* news item appeared in 1996. Suddenly he was abandoned by his friends, unemployed, and fighting the scientific establishment much as his father had fought with the Russian government, except that in his case the stakes were higher, because he believed he had made one of the major discoveries of the 20th century.

Feeling beaten down and alienated, Podkletnov says he gave up in 1997 and drove the 1,400 kilometers back to Moscow, leaving his family in Tampere. But Moscow was not a good place for a scientist to be. In the 1980s he had been able to borrow equipment freely from other scientists; in 1997, when he asked for something they would say, "How much can you pay me?"

"Russians claim they are happy now because they have freedom," Podkletnov tells me, "but they are not happy, and they are not free. If you criticize the government, you may still go to jail. If you call an ambulance, it does not come. If you call the police, they do not come. Even criminals complain that they were better off under communism. College professors are trying to live on \$200 a month in a city where prices are almost as high as in New York, and salary payments are delayed by six months. So – I returned here. I have a job, now, in a local company, as a materials scientist. It only uses perhaps 5 percent of my abilities, but –" He shrugs.

He insists that he isn't embittered. "It is good for a person to be unsatisfied in some way," he says. "You should be happy in family life but not satisfied in your surroundings. This is a source of progress. We have a proverb in Russia: The harder they beat us, the stronger we become." He gives me his twisted smile. "The only problem is, maybe they beat me so much, I never have a chance to use the strength."

I ask how people at his laboratory would characterize him.

"They say always that I am too serious. You understand, here today, I am trying to speak with humor to make your job easier. But in general I am a very determined person, very precise in everything. I don't smile when I am working. When I work, I work."

I ask him what happened to his equipment at Tampere University.

"Part of it is still there, but they don't work with superconductors any longer, and I am not allowed to come to the institute. But still, I can show you the outside of the building."

We walk out into the dark gray afternoon. "Now you are going to be a very brave person," says Podkletnov, "to ride in a Russian car." He unlocks a maroon Lada, which looks like a cheap version of an old Volvo. With another key he removes a metal clamp linking the clutch and brake pedals – a low tech security device.

But I've been told that Finland has a low crime rate. "Yes," Podkletnov agrees, "this is true. Still, there may be Russian immigrants around."

– as if his equipment were generating an invisible column of low gravity extending upward indefinitely into space, exactly as H. G. Wells described it almost a century ago.

At NASA, David Noever feels that gravity reduction should diminish with distance. Podkletnov, though, has proved to his own satisfaction that the effect has no limit; and if he's right, a 2 percent weight reduction in all the air above a vehicle equipped with gravity shielding could enable it to levitate, buoyed up by the heavier air below. "I'm practically sure," Podkletnov says, "that within 10 years, this will be done." He gives me a meaningful look. "If not by NASA, then by Russia."

But wait; there's more. He has news that hasn't been reported elsewhere. Despite the hardships in Moscow, during the past year he says he conducted research at an unnamed "chemical scientific research center" where he built a device that reflects gravity. Supposedly it's based around a Van de Graaff generator – a high-voltage

"Flying machines will reflect gravity waves – like UFOs," says Podkletnov. "I have achieved impulse reflection; now the task is to make it work continuously."

I can't tell if he's serious or joking.

The car's seat backs are almost vertical, enforcing a rigid military posture. We drive out to the university campus, which is uncompromisingly modern – and of course, the buildings are all in shades of gray.

Back in the hotel lobby Podkletnov shows me detailed diagrams of the experimental equipment that he used. "We measured the weight in every way," he says, adamantly denying that air currents or magnetism could have caused spurious readings. "We used metal shielding, we used nonmagnetic targets, we enclosed the target in a vacuum – we were very thorough."

He claims that he placed a mercury manometer (similar to a barometer) over the superconducting disc and recorded a 4-mm reduction in air pressure, because the air itself had been reduced in weight. Then he took the manometer upstairs to the lab above his and found exactly the same result

machine dating back to the earliest days of electrical research. "Normally there are two spheres," he explains, "and a spark jumps between them. Now imagine the spheres are flat surfaces, superconductors, one of them a coil or O-ring. Under specific conditions, applying resonating fields and composite superconducting coatings, we can organize the energy discharge in such a way that it goes through the center of the electrode, accompanied by gravitation phenomena – reflecting gravitational waves that spread through the walls and hit objects on the floors below, knocking them over."

And this, too, can have practical applications?

"The second generation of flying machines will reflect gravity waves and will be small, light, and fast, like UFOs. I have achieved impulse reflection; now the task is to make it work continuously."

He sounds completely sober, serious, 202 ▶

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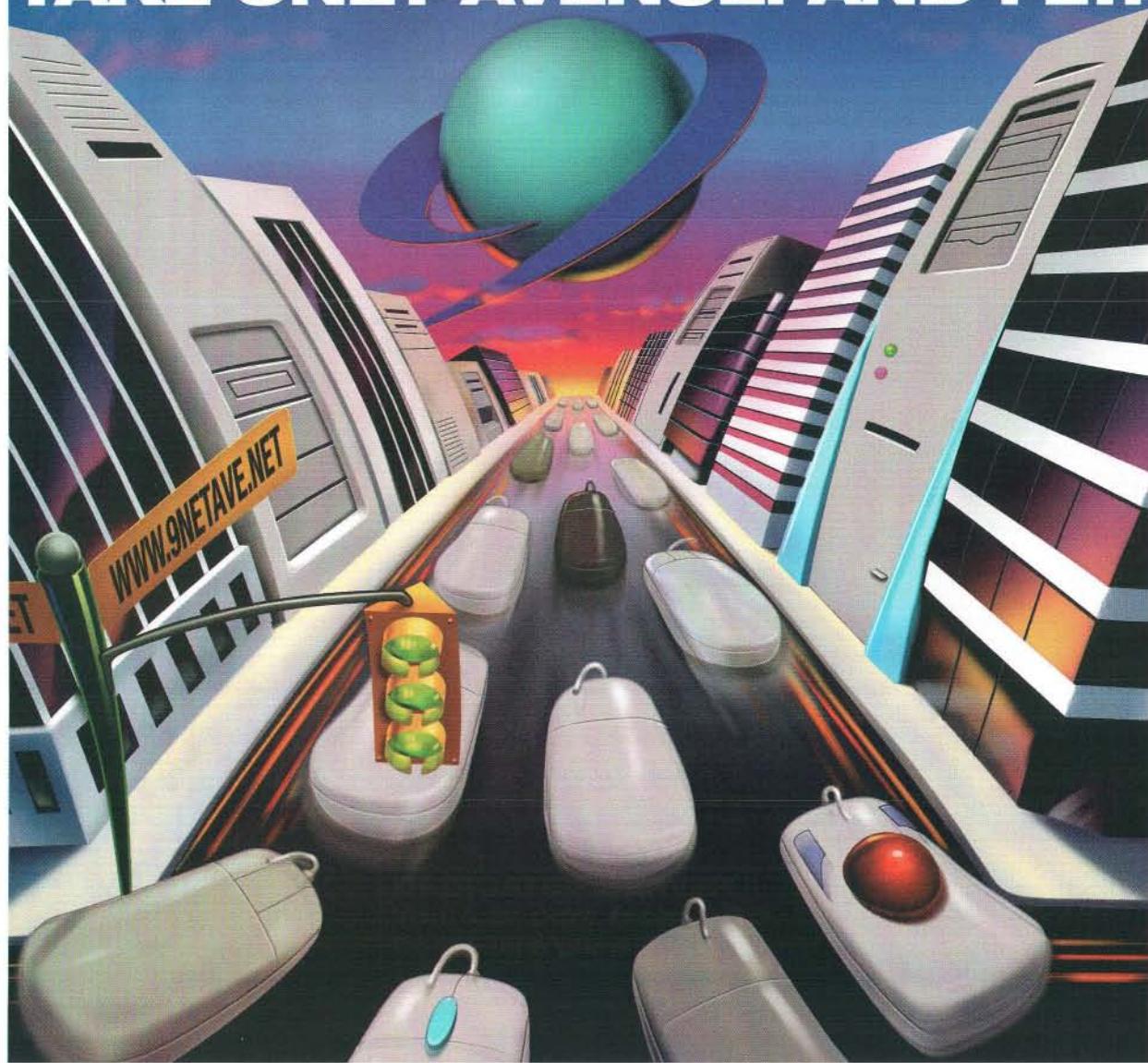


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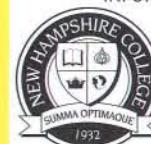
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Gravity

◀ 196 matter-of-fact.

If he really wants knowledge to be freely shared, why hasn't he written more about this? And why hasn't he been more open with the people at NASA?

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So here's a unique opportunity for the venture capitalists out there. Track down the elusive Eugene Podkletnov, make him an offer he can't refuse, and help to free humanity from its pedestrian existence at the bottom of a gravity well.

Does Podkletnov really believe that this will come to pass? He seems to. Does he see

isolation and poverty for most of his life.

As one physicist told me, "New ideas are always criticized - not because an idea lacks merit, but because it might turn out to be workable, which would threaten the reputations of many people whose opinions conflict with it. Some people may even lose their jobs."

The man who said this is an eminent physicist who started devising equipment to detect gravity waves 30 years ago. Despite his secure tenure and respected status, he still wouldn't let me quote him by name, because he suffered in the past when he promoted radical concepts of his own.

Bob Park is a physics professor at the University of Maryland. When he's pressed to say something about Podkletnov's work, he comments: "Well, we know that we can create shields for other fields, such as electromagnetic fields; so in that sense I suppose that a gravity shield does not violate any physical laws. Still, most scientists would be reluctant to conclude any-

Torr portray a superconductor as a giant "quantum object" which might be exempt from Smoot's criticism, since Einstein's general theory has nothing to say about quantum effects. As Smoot himself admits, "The general theory is widely revered because Einstein wrote it, and it happens to be very beautiful. But the general theory is not entirely compatible with quantum mechanics, and sooner or later it will have to be modified."

He also says that the nonlinear spin of gravity particles - "gravitons" - makes calculations extremely difficult. "When you add a spinning disc," he says, "the equations become impossible to solve."

This means that gravity shielding cannot be disproved mathematically. Even Bob Park, the resident skeptic, shies away from describing it as "impossible," because "there have been things that we thought were impossible, which actually came to pass." Gregory Benford, a professor of physics at UC Irvine who also writes science fiction, echoes this and takes it a step further. "There's nothing impossible about gravity shielding," he says. "It just requires a field theory that we don't have yet. Anyone who says it's inconceivable is suffering from a lack of imagination."

When I first started reading about gravity modification, I was skeptical. Most likely, I thought, Podkletnov's experimental procedures were flawed.

A year later, I'm not so sure. Having questioned him in detail for several hours, I believe that he did his work in a careful, responsible fashion. I'm no longer willing to write him off as an eccentric suffering from wishful thinking. I believe he observed something - although the exact nature of it remains unclear.

And so, frustratingly, there's no conclusive ending to this long, strange story - at least until someone provides independent verification. In the meantime, there's only one thing we can do:

Wait. ■ ■ ■

Thanks to John Cramer for factual orientation and Robert Becker for theoretical background. Pete Skeggs participated in my visit to NASA and offered extremely generous help.

"There's nothing impossible about gravity shielding," says a professor of physics. "Anyone who says it's inconceivable is suffering from a lack of imagination."

himself playing a central role? "I am not a very religious person," he tells me. "But I do believe in God, and of course there is a soul, you can feel it." He pauses, trying to convey his convictions. "Most of all," he says, "like all Russians, I have a sense of destiny. This is a secret of the Russian soul that can't be explained to foreigners. Even Russian people can't understand it. But - we feel it."

At the end of our meeting he strides out of the hotel lobby, as brisk and purposeful as an ambitious businessman, looking younger than his 43 years. I'm impressed by his intense focus, his strict attention to facts and details, and his sincerity. I wonder, though, if a vague sense of destiny is really enough to get him where he wants to go. The history of science is littered with casualties who ventured too far from the mainstream, or seemed a bit - wacky, for their time. Nikola Tesla is a classic example. Even Robert Goddard, the legendary rocketry pioneer, was scorned and forced to work in

thing publicly from this." Ironically, Park has made a name for himself by debunking "fringe" science in a weekly column for the American Physical Society's Web page. If scientists are reluctant to "conclude anything publicly," it's partly because they know they may be stigmatized by critics such as Park.

Of course, reflexive conservatism isn't the whole story. Many physicists are skeptical about gravity shielding because they believe that it conflicts with Einstein's general theory of relativity. According to George Smoot, a renowned professor of physics at UC Berkeley who collaborated on an essay that won a Gravity Research Foundation award, "If gravity shielding is going to be consistent with Einstein's general theory, you would need tremendous amounts of mass and energy. It's far beyond the technology we have today."

On the other hand, theories developed by Giovanni Modanese, Ning Li, and Douglas

Colophon

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Toys of Tomorrow

Why would Professor Michael Hawley swallow a computer? Because he plays. He plays the piano. He plays hockey. He plays with ideas. In fact, he plays with notions like running the Boston Marathon with a radio transmitter pill inside his stomach, from which his core body temperature measurements would be broadcast to any and all media willing to listen (<http://www.media.mit.edu/pia/marathonman/>).

The wild, the absurd, the seemingly crazy: this kind of thinking is where new ideas come from. In

killjoys insist, is something companies cannot afford, in terms of either money or image. Thus the duty of academic institutions to be, among other things, more playful.

This sounds simple, but is so true: When people play, they have their best ideas, and they make their best connections with their best friends. In playing a game, the learning and exercise come for free. Playing produces some of the most special times and most valuable lessons in life. Still, many teachers and parents consider the classroom and the

that appliances like refrigerators or doorknobs should be networked. But what might happen if toys were networked, too? If each Mickey Mouse and Barbie had an IP address, their population would exceed that of a small, well-connected country.

Every year, 75 percent of all toys are new, meaning newly designed that year. The toy industry lives and dies on invention. Toys gush into homes every Christmas and Hanukkah, every birthday, and lots of other days besides. This tremendous churn rate means that toys are well matched to the pace of change in the digital world. You can and should put some form of computing in a refrigerator, but a new fridge enters the house only once every 20 years. With their far faster turnover, toys may be the fastest moving and fastest evolving vehicles on the infobahn.

Toys of tomorrow will be networked. Today, they rarely intercommunicate. There is no MIDI for toys, no Internet link. Once tomorrow's powerful networks, simulators, and synthesizers are commonly interconnected through toys, a next generation of exquisite musical toys – a wonderful idea to begin with – will emerge. A toy piano that sounds like a Steinway. A baby rattle that conducts a symphony. Blocks that build a melody. Shoes that carry a tune (think karaoke for your feet). Every toy a link in a worldwide toy box.

And every toy must be inexpensive. Today's typical toy costs about US\$20, which means it wholesales for \$14, and must be built for about \$5. Forget the \$1,000 computer or the \$200 set-top box – invent a \$5 computer that doesn't look or act like a computer. That's a grand challenge for the digital industries: melt a Cray down into a Crayola.

The real toy story

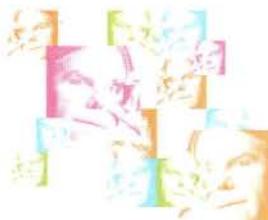
Today, a conservative computer industry still seems determined to push laptops into the hands of fat-fingered 50-year-olds, with "Net PCs" just an infrared click away from tomorrow's couch potatoes.

Surely we can do more than that. But how?

Hawley and others at MIT have been making new friends around the world to help invent toys. Their new business partners these days include Lego, Disney, Mattel, Hasbro, Bandai, Toys "R" Us, and others. Their other playmates are computer, communications, and entertainment companies like Intel, Motorola, Deutsche Telekom, Nickelodeon, and, believe it or not, the International Olympic Committee. Never before have the world's leading toymakers, technology companies, and sports organizations collaborated in such a way – which is just terrific, because the new world of digital toys won't be invented by any one group.

Nobody is quite sure what will turn up on this new road to invention. The program just started. Stay tuned. But one thing is clear: Toys of tomorrow will carry some of the most awesome and inspiring technology humankind has yet created and place it in the hands of children. Where it belongs.

Think of it this way. Being "wired" does not mean becoming "computer literate" any more than driving an automobile requires becoming "combustion literate." The power of toys is that they reach back to and shape the earliest years in our lives. One day, our grandchildren will naturally assume that teddy bears tell great stories, baseballs know where they are, and toy cars drive themselves with inertial guidance. Lucky them. ■ ■ ■



Toys may be the fastest moving – and evolving – vehicles on the infobahn.

The challenge: melt a Cray down into a Crayola.

corporate parlance it's called "thinking out of the box." At the MIT Media Lab, it's business as usual. The people capable of such playful thought carry forward their childish qualities and childhood dreams, applying them in areas where most of us get stuck, victims of our adult seriousness. Staying a child isn't easy. But a continuous stream of new toys helps.

"You get paid for this?"

Many people accuse the MIT Media Lab of being a giant playpen. Well, they're right. It is a digital wonderland overflowing with outrageous toys: all imaginable sorts of computers and interface paraphernalia.

Play, however, is a pretty serious business in the hands of students and professors like Hawley – it's 24 hours a day, seven days a week. And some profound results, both scholarly and commercial, come out of this play. Of course, a few naysayers forget that the world has a lot more money than good ideas. Such behavior, the

playground to be worlds apart. But are they?

When a young child plays with a toy, the interaction can be magic. Toys unlock that magic – part in the toy and part in the child's head. Toys are the medium and the catalyst of play. Recognizing the power of play, Hawley and company are fundamentally rethinking toys, exploring the convergence of digital technology and the toys of tomorrow – another case where bits and atoms meet. Computers have changed almost all forms of work. And, since play is the work of children, it is time to revisit the tools of their trade.

TNT: toy networking technologies

The Internet is largely composed of desktop computers, assembled like the world's biggest pile of Tinkertoys. These days, many people talk of extending the network beyond desks and into all sorts of appliances, large and small. There is no question

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